Published by F. C. W. Vogel in Leipzig.

On the Significance

of Chemical Rays of Light
for Medicine and Biology.

Three Treatises

by Prof. Dr. Niels R. Finsen in Copenhagen.
With 6 illustrations and 6 plates. Gr. 8.
1899. Price: M. 2.50.

On the Application of Concentrated
Chemical Light Rays in Medicine
by
Prof. Dr. Niels R. Finsen in Copenhagen.
With 4 illustrations and 2 plates.
Gr. 80. 1899. Price: M. 1.20.

Communications

from Finsens Medicinske Lysinstitut (Finsen's Medical Light Institute)

in Copenhagen.

I. P. Edited by Prof. Dr. Niels R. Finsen

The German edition edited by Dr. Valdemar
laboratory assistant at
the institute. 1900, 1901, price 3 marks
Bie, each.

Printed by August Pries in Leipzig.

FINSEN, MEDICAL LIGHT INSTITUTE, III. HERT.

4/16 5 – 4/3 03

COMMUNICATIONS FROM

FINSENS MEDICINSKE
LYSINSTITUT (FINSEN'S MEDICAL LIGHT INSTITUTE)

IN COPENHAGEN

III

EDITED BY

PROF. DR. NIELS R. FINSEN

THE GERMAN EDITION EDITED

BY DR. VALDEMAR BIE
LABORATORY ASSISTANT AT THE INSTITUTE

LEIPZIG
PUBLISHED BY F. C. W. VOGEL 1903

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Foreword.

Dr. G. J. Müller (Berlin) has kindly undertaken the major task of proofreading the translation, for which we hereby express our sincere thanks.

The translation of the book was done by Dr. Schramm

On the Application of Concentrated Chemical Light Rays in Medicine.

Continued reports by Niels R.

Finsen.

Since I published my treatise "On the Application of Concentrated Chemical Light Rays in Medicine" in December 1896, which was accompanied by a "Preliminary Report on the Application of the Method in Lupus Vulgaris," conditions have changed quite significantly. While at that time I had only used the method for one year and in two cases of lupus vulgaris, it has now been used for six years and in over 800 cases of lupus vulgaris, as well as in many other ailments. What was an interesting, promising experiment at the time has now proven to be significantly more, and the method has not only kept its promise but in many respects has far exceeded my expectations

The first and most important investigations on which the method is based are published in the above-mentioned treatise, but not my later investigations, which aimed to improve and expand the method.

In the various, quite numerous, communications I reports on the treatment method that have so far come from the Light Institute (see list in "Reports from Finsen's Medical The Light Institute," I, p. 4) have essentially concerned the results of the therapy, followed simultaneously by reports on the essential changes and improvements in the treatment apparatus. On the other hand, almost nothing has been reported about why the changes were made; I intend to publish these underlying investigations here. At the same time, I want to provide a description of the method and its current status, both from a technical and therapeutic perspective

These investigations, most of which date back 4-5 years, are mainly of a physical nature; they have the quite natural characteristic of being conducted exclusively with a specific and practical goal in mind, as if by a non-physicist. Despite the resulting deficiencies, I still want to publish them, as there is a certain reason to do so. The method and my apparatus are already used in numerous foreign countries, and I therefore owe an explanation as to why the apparatus and the method are exactly as they are, why, for example, one needs glass lenses for sunlight and quartz lenses for electric light, why one should use clear distilled water for electric light-collecting apparatus and bluish-colored water for solar-collecting apparatus. These and other relationships

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1) In carrying out these investigations, I received a great deal of help and support from my two assistants at the time, Doctors Valdemar Bie and Axel Reyn, to whom I hereby express my sincere thanks

seem to contradict each other and require a more detailed explanation. If I do not provide the explanations and the underlying experiments, I run the risk that the apparatus and technique will be changed in the wrong direction, to the detriment of the method.

First, I must make the remark that some of my investigations may be regarded as superfluous because the conditions are considered known. To this, I can only reply that, since it turned out that various physical data I had found on my subject (concerning the absorption of rays, etc.) did not agree with my experiences, and since the luminous intensity involved in my experiments far exceeded the luminous intensity usually used in experiments, I considered it most correct to reinvestigate almost all of the relevant questions

The types of these investigations naturally follow from the principles underlying the method, and these are, as is well known, 1. the use of the bactericidal and inflammatory ability of light, and 3. its ability to penetrate human tissue. 2. the

In order to be used in practice, the light must be highly concentrated and, at the same time, the large amount of heat must be eliminated to prevent the burns that the concentrated light would otherwise cause.

The questions that therefore demanded answers were the following: 1. Which rays in the spectrum are the most bactericidal? 2. To which rays is the inflammatory effect linked? 3. How

How can the annoying heat rays be eliminated most easily and best without simultaneously losing the useful, bactericidal and anti-inflammatory rays? 4. What is the situation regarding the penetration of light into tissue? In addition, other questions arose which also concerned light and which were partly dependent on the answers to the previous ones, namely: 1. What can be done to produce an artificial light that is rich in rays with the desired properties and poor in heat rays? 2. Which part of the electric arc light is the best, that which comes from the carbons or that which comes from the arc? 3. How does sunlight differ from electric light, and what significance does this difference have, partly for the construction of solar apparatus and partly for the treatment of patients?

This is followed by a series of investigations into how best to produce concentrated light so that as many of the beneficial properties as possible are retained and the detrimental heat rays are avoided as far as possible.

I will, if possible, treat each of the individual questions separately and either answer them or point out where an answer can be found.

1. Which rays in the spectrum are the most bactericidal?

I was already able to answer this in my above-mentioned first treatise (p. 6) that, as a result of numerous investigations, which I also found confirmed in my own experiments, the most refractable, the blue-violet rays, had —to be regarded as the most bactericidal, although some differences of opinion

arose regarding the most refractable of all, the ultraviolet rays. In more comprehensive investigations, which were later carried out at the Light Institute by Dr BIE1) on this extremely important point, and to which I refer, significantly more clarity has been disseminated regarding how extraordinarily large a part of the bactericidal effect of light is attributable to the most refractable rays and how small a part is attributable to the less refractable rays (the red and yellow). Dr. Bie's investigations were carried out with the help of collecting apparatus equipped with glass lenses, and his results are of the greatest importance for all rays that can pass through glass; but a large part of the ultraviolet rays is known to be absorbed by glass, whereas they diffuse rock crystal. It was now of great importance for the method to know how important these ultraviolet rays absorbed by glass are as bactericidal; this would determine whether rock crystal lenses should possibly be used for light-collecting — apparatuses, instead of the — glass lenses used until then.

I therefore conducted an experiment in this direction (on May 22, 1897, at 10:30 p.m.), which I report based on my book of experiments.

The light from an 80-ampere lamp was collected with the help of a small collecting apparatus consisting of a metal tube 6 cm long; one end of which was closed with a rock-crystal plate 6 cm in diameter, and the other end with a rock-crystal lens 5.5 cm in diameter and 6 cm focal length, with distilled water between them. With the help of this apparatus

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1) Investigations into the bactericidal effect of the various parts of the spectrum. Reports from Finsen's Medical Light Institute, I, p. 40

The light was collected on a 6 mm diameter spot of a Prodigiosus plate culture, as we usually use it in the Light Institute, except that in this experiment I let the light fall directly onto the culture, i.e., onto the surface facing away from the glass. I made three experiments, each lasting 5 minutes. In the first experiment, a rock crystal plate was placed between the collecting apparatus and the culture; in the second experiment, a glass plate made of ordinary window glass; and in the third experiment, a somewhat thicker plate made of clear mirror glass. The examination, carried out the next day at 1:30 a.m., showed a weakening of the growth on all three spots. In the two spots where the light had passed through glass plates, the growth was approximately uniform, but very slightly weakened; much more pronounced, however, where the light had passed through the rock crystal plate (the three spots were side by side on the same plate culture). During the examination carried out the next day (the 24th) at 32:30 p.m., the illuminated area on the rock crystal plate was clearly visible; here the majority of the bacteria had been killed, and only a few isolated colonies had grown. On the two glass plates, however, growth was equally good on the illuminated and the unilluminated areas; the bacteria were pigmented everywhere, only somewhat darker in color on the illuminated than on the unilluminated part. This result, which I found confirmed in later experiments, shows an extraordinary preponderance of bactericidal ability in extreme ultraviolet rays. A necessary consequence of this experiment was the introduction of rock crystal lenses instead of glass in the treatment apparatus, and with this, as is understandable, an extraordinary amount was gained. How much was gained by this change

I can't give an exact figure, but you'll get an idea if I give you a few numbers. Dr. Bie found in his investigations that concentrated light from a 35-ampere lamp, concentrated through a glass collecting apparatus, killed a Prodigiosus culture after 35 minutes of exposure. Using a rock crystal collecting apparatus (with 7 cm lenses) and a lamp of the same size, I was able to kill a culture of the same bacteria in 2-3 seconds

In order to investigate how it behaved with sunlight, I later carried out some experiments, which were arranged according to exactly the same principle as the last-mentioned experiment with electric light. For this, I needed a collecting apparatus with a rock crystal lens 10 cm in diameter. The result here was quite different, as there was a very slight difference in the effects, regardless of whether the light had passed through rock crystal or through a thick plate of mirror glass. The sunlight that had only passed through rock crystal had the same effect on Prodigiosus in 4 minutes as light that had passed through a plate of glass had in 5 minutes.

From this, one gets a very good practical impression of how great the difference is between sunlight and strong electric arc light, with regard to the content of extreme ultraviolet rays retained by the glass. Sunlight contains relatively

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1) This number could not be considered an absolute target for the difference in the performance of the apparatuses, since there are so many sources of error with regard to the cultures that were not taken into account in these experiments (see S. Bang's treatise: "On the Effects of Light on Microbes." Reports from Finsen's Medical Light Institute, II, p. 1); but it does give an approximately correct idea of the great difference between these two Arfen apparatuses

very few of these rays, due to their high degree of absorption by the atmosphere. From this it follows, for example, that sunlight on high mountains is much richer in these rays than in the lowlands (see Absalon Larsen's treatise: "On the Intensity of Sunlight." Reports from Finsen's Medical Light Institute, I, p. 99). In the strong, electric arc light, however, by far the largest part of the bactericidal effect is due to these ultraviolet rays.

Theoretically speaking, as a result of these experiments, one should use collecting apparatus with rock-crystal lenses for both sunlight and electric light, since such apparatus will definitely give better and stronger light. But in practice, the ratio is different

I will first discuss how it behaves with sunlight. Since the rays are parallel here, the intensity of the light, all other things being equal, depends on the size of the lens area. This ratio is very favorable with regard to glass; since one can easily obtain glass lenses as large as one needs them; but unfavorable with regard to rock crystal lenses, since the limits for the size of lenses of this type of stone are very narrow. The largest rock crystal lens that I have seen and could obtain had a diameter of 11.5 cm; but such lenses are very rare and very expensive; whereas one can fairly easily obtain rock crystal lenses with a diameter of 7 to 8 cm, although these are, of course, also expensive.

From my experiment with bacteria described above, it emerged that one can roughly determine the ratio between a rock crystal lens and a glass lens of the same diameter, the same

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1) While rock crystal lenses with a diameter of 10-11 cm cost 150-200 kr., those with a diameter of 7-8 cm cost approximately 30 kr. each.

focal length and the same thickness, could be specified as 5 to 4 when it came to utilizing the bactericidal power of sunlight; in other words, only a very slight increase in diameter is needed to make a glass lens equivalent to a rock crystal lens. For example, a glass lens with a diameter of 11 cm is equivalent to a rock crystal lens with a diameter of 10 cm. But if one further considers how disproportionately the area increases in relation to the diameter, so that, for example, a lens with a diameter of 20 cm has an area four times as large as a lens with a diameter of 10 cm, one will understand how disadvantageous the use of rock crystal lenses would be for sunlight.

It is different with electric light Firstly, the usefulness of rock crystal, as I have shown, is extraordinarily greater here than with glass, and secondly, the size of the lens area plays a significantly smaller role because the rays are diverging. If a lens with a small area is placed close to the light, it can, as is well known, collect an equal or even greater amount of light than a lens with a much larger area placed at a certain distance from the light. Of course, the size of the lens is not absolutely irrelevant, since placing it too close to the glowing coal tips entails certain practical disadvantages (they crack easily and are quickly dusted by the carbon particles constantly falling during the combustion of the coal). However, at a reasonably large distance from the arc (12-15 cm), these disadvantages are not very great, or at least small compared to all the advantages of using rock crystal. Even the high price of these lenses is of secondary importance if one considers the high cost of these lenses.

considering the tremendous difference that exists between glass and rock crystal compared to this light. 1)

2. To which rays is the inflammatory effect linked?

I can limit myself to answering this question very briefly by referring to my treatise: "New Investigations on the Effect of Light on the Skin" (Reports from Finsen's Medical Light Institute I, p. 8), where I made it the subject of detailed investigations. The answer is that it is exactly the same rays that have a bactericidal effect and that there is the same, or approximately the same, difference in the effects on the skin as on bacteria with electric light that has passed through glass or that which has passed through rock crystal. 2) As a consequence, everything applies

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1) This transition to the use of rock crystal lenses with electric light was, incidentally, actually a return, since I had already needed a rock crystal collecting apparatus for lupus treatment in the winter of 1895-1896. The development was as follows: I began (in November 1895) with a glass lens, but it soon became clear to me that rock crystal was — theoretically preferable. I therefore obtained rock crystal lenses that same winter. But since they turned out to be extraordinarily expensive and could only be obtained in very small diameters, I returned to glass lenses. This return to glass was certainly quite correct at the time; partly because I only had a weak arc lamp with relatively few ultraviolet rays at my disposal at the time, and partly because I had not yet arrived at the use of the double lens system (with spaces between parallel rays), which completely changes the situation and, so to speak, eliminates the advantage of the large-diameter lenses

2) Whether they are exactly the same rays cannot, of course, be said with absolute certainty; but as far as one can judge from the methods of investigation currently available, they are the same.

What I said in the previous section also applies in this section. In order to produce the most powerful possible effects of light, it is most appropriate to use rock crystal lenses in electric light and glass lenses in sunlight.

3. How can one most easily and best eliminate the irritating heat rays without simultaneously losing the useful, bactericidal and anti-inflammatory rays?

Completely eliminating the heat of light is a physical impossibility, since all rays of light have the property of generating heat, only to varying degrees. Therefore, in the question posed, I spoke only of the "generating" heat, and what I understand by this expression I can state quite definitely in numbers. In numerous measurements of the heat of the light cone, which patients could tolerate without feeling pain, I found that 45–55°C can be set as the average for what is tolerable.

The task now was to construct apparatus that could produce a light cone with the highest chemical luminous power without exceeding this temperature at the focal point. The work involved was partly of a common nature, partly different for electric light and sunlight, so that I must partly treat each separately

I need hardly note that, hand in hand with these various investigations and as a result of them, the construction and reconstruction of collecting apparatuses were continually being made, so that various intermediate stages lie between the apparatuses which we need now, and those discussed in my above-mentioned book of 1896. It is not worth the effort to dwell on most of these transitional forms; I will only discuss the most essential ones below.

Common to both types of light were the investigations into the ability of water and various solutions to absorb heat rays and chemical rays. I have already discussed some of the investigations in this direction in my treatise of 1896; but the most essential investigations were carried out later

The questions that needed to be answered, with regard to the clear, uncolored water, were the following: What is the absorption by the water with regard to a) heat rays and b) chemical rays? c) What is the significance of the thickness of the water layer? and d) What is the significance of the temperature of the water? This was followed by e) investigations into the light absorption ratio of the various solutions in order to find the solution best suited to the collecting apparatus, i.e., the solution that absorbed the largest part of the heat rays and the smallest part of the chemical rays.

a) The absorption of heat rays by the water.

For these and the following experiments on absorption, I used the light from a 35-amp arc lamp, which was concentrated with the help of one of my electric light-collecting apparatuses as described in 1.c., p. 19. To determine the temperature, I used a mercury thermometer whose bulb was blackened with soot

was. In all experiments, the thermometer was held at the same point on the light cone, at its focal point.

First, I measured the temperature without filling the apparatus with water; it showed 325° C. (Mean of three measurements: 290°, 360°, and 324°). I then filled the apparatus's container with water, and the thermometer now showed 111°. (Mean of 6 measurements, which varied between 89 and 123°.) The thickness of the water layer passed through by the light was 13 cm.

The rather large difference in temperatures in the experiments, which were carried out with quite large intervals, is to be attributed to the lamp, whose light is rarely uniform in the same place for any length of time; for even if the current and voltage are kept completely unchanged, the shape of the crater, for example, can produce a large difference in the luminous intensity. For my purposes, these results were nevertheless subtle enough

One can see that the layer of water has reduced the temperature of the light by more than 200. Since we now know that water absorbs only a very small amount of the visible rays of light, this loss of heat must be due mainly to the absorption of the invisible, ultra-red rays of light.

To find out whether all of the ultra-red rays or how large a portion were absorbed by the layer of water, I placed a 1-cm-thick light filter filled with an opaque solution of iodine in carbon disulfide between the apparatus and the thermometer (this solution absorbs all light rays except the ultra-red ones). The thermometer now showed 26° (room temperature 20°). From this one can see that the layer of water has almost completely eliminated the ultra-red rays. If

I placed the same filter in front of the collecting apparatus to conduct Before a control experiment and simultaneously emptied the water container, the temperature at the invisible focal point rose to 172°.

b) The absorption of chemical rays by water.

is the most penetrative, or one of the most penetrative, liquids for the chemical rays of light, and experiments can show that the loss of the chemical effect of light through passing through a layer of water is actually quite negligible. When it comes to glass apparatus, it can even be demonstrated that the water is beneficial; if one measures the chemical effect of the light cone after it has passed through an empty glass light filter, and then measures the effect after the light filter is filled with water, one will see that the effect is strongest in the latter case; this is explained by the fact that the reflection from the glass sides is less when there is water in the filter than when it is empty I carried out my experiments by allowing the light cone to act on silver chloride paper (Aristo paper). The paper was placed on the same spot on the light cone in all experiments, and the experimental time was the same for all comparative experiments. By then comparing the colors on the areas blackened by the light, I was able to obtain a quick and, for my purposes, sufficiently reliable idea of the absorption of chemical rays. 1)

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1) As far as I —remember (I have not noted anything on this in my experiment book), all my experiments were carried out with distilled water,

c) The Significance of the Thickness of the Absorbing Water Layer

In practical terms, it is of great importance whether the collecting apparatus should be constructed with a thick layer of water or whether a thin layer can be sufficient. For apparatus for electric light, this is relatively less important, since these are fixed and supported by strong iron arms. For solar apparatus, however, this question is of great importance. If the water layer is large, the apparatus becomes very heavy and unwieldy. As an example, I will cite the solar apparatus described in my above-mentioned book on page 17; it has a water layer 40 cm thick and contains 10 liters of water. Because of its weight, it was difficult to transport, its use was cumbersome, and it is therefore no longer used

I carried out the relevant experiments with the same lamp, the same apparatus, and in the same manner as described on page 12, gradually filling light filters of different thicknesses with water and placing them between the apparatus and the filter. Since I did not have filters of all thicknesses, I sometimes placed several filters one behind the other, which does not correspond absolutely to the same thickness of a single filter[1]), but as the figures show, this plays no essential role in such crude experiments as mine. —

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which we always use with apparatus and light filters. There is a difference between ordinary and distilled water with regard to the absorption of the extreme ultraviolet rays (see Absalon Larsen's treatise, Mitteilungen II, p. 110).

1) The more glass surfaces the light passes through, the greater the loss of light due to reflection

The results of these experiments are recorded in the table below, in which I list the thickness of the water layer, the number of filters, and the temperature.

Thickness of the water layer	Number of filters	Temp. at focus.
0	0	325° C.
1 cm	1	180°
2.5 cm	1	126° ,,
3.5 ,,	2	114°
13 ,,	no filter but water in the same apparatus	111° ,,
26 ,,	Water in the apparatus + in the filter	107° ,,

One can see from this table how important even a thin layer of water is, and what comparatively little advantage one gains by making the water layer very thick. Consequently, one should not use a thick layer of water, since this has the inconvenience of making the apparatus heavy and unwieldy, whereas it would be more convenient to use a thick layer of water where these considerations do not need to be taken into account. With solar apparatus, which have a large diameter and must be frequently moved from one place to another, this plays a major role, as stated above; therefore, in the latest designs of these apparatus, I use a water layer only 4-5 cm thick. With electric light apparatus, the relationship is reversed; the lenses have a small diameter, and the apparatus is firmly attached, therefore

one can use a thick layer of water here without any inconvenience; therefore, for the latest designs, I need a water layer of 35 cm.

d) The importance of the temperature of the absorbing water layer

assume that the temperature of the water layer must be important when it comes to the absorption of heat rays, in such a way that cold water absorbs more than this seems to be the general opinion, since almost all medical investigators warm absorbed. One should who have worked with light without heat emphasized allowing the light to pass through a layer of water that was constantly kept cold. A decision on this question was all the more necessary for me because the water in the light-collecting apparatus became very warm after a few hours, almost reaching boiling point, and cooling the water by constantly flowing cold water through it in one way or another was a very complicated process, which I only wanted to resort to if it was absolutely necessary

My experiments on this topic were carried out with the same lamp, the same apparatus, and in the same manner as in the above-mentioned investigation. There was no water in the apparatus itself, but a light filter 1 cm thick was placed between the apparatus and the thermometer. This light filter was gradually filled with water at 5°, 45°, and 73°. The corresponding temperatures, measured at the focal point, are shown in the table below. I cannot remember how many experiments of this type I conducted; in my book, only the following are noted:

Filter of 1 cm	Water 50	T. 174°
,, ,, ,, ,,	,, 45°	,, 198°
,, ,, ,, ,,	,, 73°	,, 180°

After these measurements, whose variations can be considered within the normal limits of error (see p. 13), I had seen in any case that there was no significant difference in the absorption capacity of the water, regardless of whether it was cold or warm, and I therefore considered it unnecessary to make any arrangements to cool the water in the collecting apparatus. If I nevertheless later (see p. 38) switched to cooling the water in the apparatus, there were other reasons for this

Before I conclude my remarks on water, I would like to point out that it is absolutely necessary to use freshly distilled water for both solar apparatus and electrical apparatus. Apart from the possible absorption ratio (see Absalon Larsen's article cited above, p. 110), there are two practical considerations that make the use of ordinary water disadvantageous. First, as the water heats up, numerous air bubbles are deposited on the lenses, causing them to lose an extraordinary amount of luminous intensity. Second, ordinary water gradually deposits calcium salts. We have also tried using boiled water, but have not been able to obtain sufficient clarity so far.

e) Investigations into the absorption of heat and chemical rays by various solutions.

As discussed in my above-mentioned treatise (pp. 14-15), I used both

For both electrical and sunlight, a solution of methylene blue removes even more heat rays from light than water alone is capable of. In order to find out which solution is best able to absorb heat rays and at the same time allow chemical rays to pass through, I undertook a series of experiments.

First, I spectroscopically examined all the clearly soluble blue dyes that I was able to create; I found that methylene blue, alkali blue, and an ammoniacal solution of copper sulfate best met our requirements. The first two showed an almost completely uniform absorption spectrum when examined spectroscopically, but the methylene blue spectrum was apparently the most favorable, and with this substance and the ammoniacal solution of copper sulfate, I therefore carried out a series of comparative experiments to directly determine, with the aid of a thermometer and photographic paper, their ability to retain heat rays and allow chemical rays to pass through

Since these are the same dyes that I discussed in my above-cited treatise, and since later, more detailed investigations have shown that the assumption I made at that time was not entirely correct, I will cite what I said then and correct the circumstances at the same time. It says in 1. c. p. 15: "Since the ammoniacal solution of sulfuric acid of copper oxide quickly stains upon contact with the metal sides of the apparatus and its use is otherwise less pleasant, I have now switched to methylene blue solution. The sulfuric acid solution of copper, if sufficiently strong, does not include 2* completely extinguishes the red rays, but a strong methylene blue solution does not. On the other hand, upon spectroscopic examination of a weak, apparently equally intense solution of the two colors, one will see that the methylene blue solution absorbs more red rays than the copper sulfate solution; and since, as a rule, one only has use for a partial exclusion of the red rays, the methylene blue solution is preferable for this reason as well.

The experiments I wish to discuss here were carried out with the same lamp and the same collecting apparatus as in the above-mentioned experiments on the absorption of water, and with the same 1 cm thick light filter. The temperatures mentioned here could therefore easily be compared with the temperature (180°) discussed above for a layer of water 1 cm thick; such a comparison provides a numerical impression of the filtration of light through blue-colored water

For the experiments, I prepared two deep blue, apparently uniformly colored solutions of methylene blue and copper sulfide with ammonia. The light filters with these solutions were then placed alternately in front of the light cone, and the temperatures at the focus were measured.

The result of the experiments was that I found a mean value of 61° for the copper solution and 116° for methylene blue (for clear water, the temperature was, as mentioned, 180° under the same conditions). By testing the effects on photographic silver chloride paper, it was shown that the copper solution allowed more chemical rays to pass through than the methylene blue solution.

Water was then added to the collecting apparatus.

(a 13 cm water layer). The temperature was 111°C, as mentioned above; when the copper filter was placed in front, the temperature at the focus fell to 34°C; when the methylene blue filter was placed in front, it fell to 57°C.

The solutions used here were, as mentioned, quite dark; in experiments with a weaker solution (the same solution half diluted with water) and with water in the collecting apparatus, the temperature at the focus was 45°C for the copper solution and 580°C for the methylene blue solution.1) This last experiment, however, demonstrates the correctness of what I said at the time about the difference between a weak and a strong methylene blue solution compared with the copper solution. The main result, however, remains that, both with regard to heat removal and the lower absorption of chemical rays, the ammoniacal solution of sulfuric acid of copper oxide is absolutely preferable

I also conducted comparative experiments, arranged in the same way as these last, between an ammoniacal copper sulfate solution and various solutions that are said to have a particularly high absorption capacity for heat rays, namely: solutions of alum, ferric sulphate, iron chloride, and others. But the result was that the copper solution was far preferable to the others. For these reasons, we now always use copper solutions for collecting apparatus when more heat is to be absorbed.

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1) Since it is surprising that this number is approximately the same as for the stronger methylene blue solution, I will cite the results of the individual measurements. Both numbers were the average of three measurements; for the strong solution, the temperatures were 570, 540, and 610; for the weak solution, 690, 480, and 560

should be greater than water alone can achieve. We attempt to reduce the disadvantages mentioned in the use of copper solutions (rapid decomposition, etc.) by coating the metal that comes into contact with the solution with asphalt varnish.

We constantly need copper solution for sunlight-collecting apparatus, as it offers greater advantages. We also needed it for electric light-collecting apparatus for a while, as long as we still used glass lenses; but since rock-crystal lenses were introduced, the copper solution could no longer be used, as it absorbs chemical rays to an even greater degree than glass in the liquid thicknesses under discussion here.

4. The penetration of light into tissues (compressed glass).

To enable the chemical rays to penetrate the tissue as deeply as possible, we always use a pressure glass, which pushes the blood away from the area to be treated, which, as I have demonstrated (1. c., pp. 31-33), is of great importance. This is, of course, most important when treating deeply infiltrated areas. On the other hand, we have learned that with very superficial affections the goal can also be achieved without a pressure glass, e.g., in some cases of superficial lupus of the

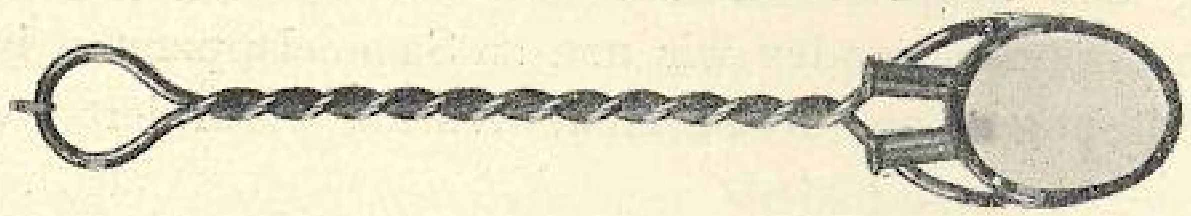

Fig. 1. Half natural size.

canthus and the upper eyelid, where it was not possible to use a pressure glass because of the condition of the eye

It is clear that the pressure glasses must be shaped differently depending on the places where they are to be applied. In addition to the shapes discussed earlier (see 1. c. p. 33), I will also mention a pressure glass with a concave plate (for treating the vertex) and a special shape, a small oval pressure glass with a handle (see Figure 1), which we use for treating the canthus of the eyes and other places where it is difficult to use the ordinary pressure glass.

Of greater importance is a change that I introduced (1897) in the pressure glasses and which I will discuss in more detail, since it actually represents a great improvement in the method from a practical point of view. This change consists in the use of a hollow, water-filled pressure glass through which cold water flows continuously by means of a supply and discharge tube

In the constant endeavor to eliminate the uncomfortable warmth of light, I had, as can be seen from the foregoing, essentially attempted to approach this goal with the help of media that absorb heat rays. I had, in fact, experienced that the sensation of warmth diminished as soon as the pressure glass was pressed against the skin; but one day, when I experimented with the light of a collecting apparatus on my arm and felt a strong burning sensation, even though the light had passed through a thick layer of water, we tried sprinkling water over the skin, and the sensation of warmth disappeared completely. The same thing happened when a pressure glass was placed on the skin and surrounded by water trickled over. Further experiments showed that even extremely warm light, which immediately caused the most terrible pain on the arm, could be tolerated as soon as the skin was covered with a pressure glass over which water was trickled. Since constant trickling is, however, not easy to carry out in practice in the treatment of patients, I tried to see whether a hollow pressure glass filled with cold water could be sufficient. The experiment showed, however, that the advantages brought about by the constant changing of the water were so disproportionately great that I decided to introduce the hollow pressure glasses with flow mentioned above Through this change, the pressure glasses, or as one should rather call them, pressure apparatus, have been given two functions: partly to press away the blood, and partly to have a cooling effect on the skin (through conduction). These two functions are so important and essential, and of such great significance, that the third effect they exert, namely to absorb heat rays, is completely disregarded from a practical point of view.

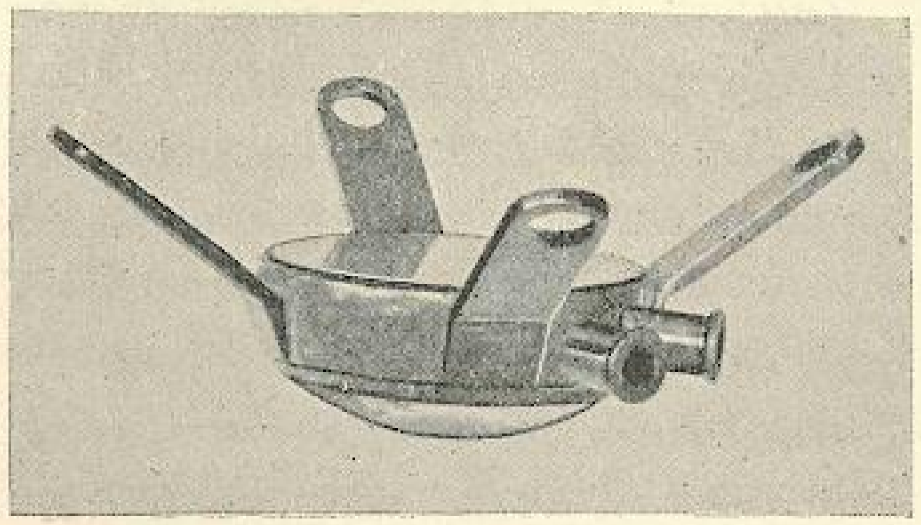

Fig. 2. 2/3 natural size.

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1) While, as I have previously demonstrated, it is quite unimportant whether the water in the containers of the collecting apparatus contains warm or cold water, since the water's absorption capacity for heat rays is approximately the same in both cases, the situation is quite different with the water in pressure glasses, which is supposed to have a cooling effect through conduction; in this case, the colder it is, it naturally cools the skin more.

can be left. As soon as there were no water in the collecting apparatus, they would be of great importance, since even a thin layer of water (see my table on p. 16) is of extraordinary use. However, since the provision of a layer of water in the collecting apparatus does not pose a disadvantage, but on the contrary brings a great advantage, since the water layer can be made very thick in one case (electric light) and blue in the other (sunlight), this arrangement is naturally preferable. From the table above, one can also see that the heat radiation absorption of the pressure apparatus is practically irrelevant, since almost all heat rays that can be absorbed by water are already absorbed in the collecting apparatus

The great practical importance of the introduction of these pressure apparatuses with water trickling through them is perhaps best illustrated by the following experiment. I attached a hollow pressure apparatus to my arm, through which water (12°C) flowed, and then exposed my arm to the light cone of a large sun-collecting apparatus (a glass lens of approximately 30 cm diameter filled with clear water). I then tested how close I could bring my arm to the focal point without feeling pain. The distance from the lens was then measured, and a mercury thermometer, the bulb of which was blackened with pine soot, was placed at exactly the same spot. The temperature showed a height of 220-230°C; a small piece of wood, which was placed in the same place—where my arm had been—immediately emitted columns of smoke and glowed. If one considers that the temperature of the light cone, which had generally been achieved with the pressure apparatuses used up to that point—

was 45-55° C., then one will understand how important this improvement in pressure apparatus was, and how much stronger light we were able to use in treatment after its introduction. While previously we were not allowed to use lamps stronger than 35-50 amps, we could now use those of 60-80 amps

The reason that the skin can be exposed to radiant heat without pain or harm, which under other circumstances would carbonize it, is, of course, that cooling, the conduction of heat, occurs more quickly than the warming of the skin through absorption of the rays. A material that conducts heat well is therefore preferable, and since rock crystal, like all other precious stones, is a significantly better conductor of heat than glass, its use in pressure apparatus is preferable to glass for theoretical reasons. I will add that this advantage in conductivity is large enough to also have practical significance. Since, as discussed previously (p. 6), we introduced rock crystal lenses in collecting apparatus for electric light, we naturally did the same for pressure apparatus; thus, one sees that there are two reasons for using rock crystal; and one now understands the apparent lack of consistency in using collecting lenses made of glass for sun treatment but pressure apparatus made of rock crystal

Collecting Apparatus for Sunlight.

Their form has changed not so little over time as a result of the previously described investigations into the absorption of light. From the form of collecting apparatus which we described in 1. c. p. 17

to the form which we currently use, and which has undergone no essential changes in the last three years, there have been numerous transitional stages. Although it might seem unnecessary to discuss these transitional forms, I will nevertheless do so in the case of some of them in order to have the opportunity to explain why we were not satisfied with these forms; this is the best way to prevent others from taking the same path again in the belief that they are making improvements

The solar apparatus, described in 1. c. p. 17, but which was by no means the first form, consisted of two solid glass lenses, one 30 cm in diameter and the other 18 cm; between these two was a layer of water 35 cm thick. The apparatus contained 10 liters of water, was difficult to transport and set up, and so difficult to move from one place to another that we often preferred to change the patient's position according to the movements of the sun.

In the investigations discussed earlier (p. 15) on the importance of the thickness of the water layer, it had since become apparent that such a thick water layer was of relatively little advantage. I therefore constructed the following solar apparatuses with a much thinner water layer, which made them considerably more manageable

Because the large, solid glass lenses were relatively expensive, I tried to get hold of some hollow glass lenses; but since I wasn't lucky enough to find a glassworks that could or would make them, I tried using large watch glasses cemented into a metal ring. These lenses were considerably cheaper, but only became really usable after were about 10 times cheaper than the others), I went back to using solid glass lenses, but in such a way that only one side of the apparatus consisted of a lens (flat-convex, with the flat side facing the water), while the other consisted of a flat mirror glass plate

It soon became apparent that, for reasons I will return to later, it was impractical to use very large lenses (40 cm in diameter). The size 20-30 cm in diameter proved to be the most useful, and a lens of this size was not difficult to obtain, but only one with a fairly strong curvature. The resulting consequence was the rather short focal length of the lens (30-40 cm), which is why the collecting apparatus always had to be placed very close to the patient. Since this proved very uncomfortable, I proceeded to make one side of the lens flat by using mirror glass instead of the one curved lens; this doubled the focal length and made the use of the apparatus much more convenient. This is the simple reason why the lens in solar apparatus is always flat-convex, a relationship that constantly gives rise to many questions

In the meantime, I have not yet succeeded in obtaining glasses as good as I could wish for. Due to the manufacturing method—as far as I know, a large sphere is first blown, from which the lenses are cut out as segments—they are never completely accurate and never collect the light as well as ground, solid lenses; the cross-section of the light cone at the focal point is often irregular (angular, oval, etc.). Since I thought that perhaps more was actually lost through this irregularity than what was gained in the other direction, namely through the cheapness of the lenses (they

I obtained curved glasses, specially made for this use. However, it was only successful after numerous unsuccessful attempts, since some technical difficulties are associated with making them of significant size and exactly spherical

This had the advantage that the light was nicely collected, so that the light cone was regular and round at the focal point. A further advantage was that the blue-colored water layer was the same thickness everywhere. If, on the other hand, the lens is made of curved glass, the water layer is naturally thickest in the middle, which is disadvantageous because the central rays (which are considered the most valuable because they can be collected best and are refracted least) have to pass through the thickest water layer and are thus absorbed more strongly than the peripheral rays. But when I conducted comparative experiments with two apparatuses of the same diameter and under exactly the same conditions, it turned out that the apparatus with curved glass, despite its lesser ability to collect light, killed bacteria more quickly than the apparatus with a solid lens. This difference must undoubtedly be due to the greater absorption of chemical rays by the thicker glass. Here, therefore, the cheapest was also the best

In order to possibly eliminate the disadvantage of the greater thickness of the blue water layer in the center than in the periphery, which was particularly important with large apparatuses when the liquid was to be relatively dark in strong sunlight, I conducted some experiments.

I constructed some apparatuses whose lens was filled with clear water; either in front of or behind it, I placed a light filter with flat walls, and filled with the blue liquid. In other apparatuses, I used blue glass plates instead of filters, so that one could use one in weak sunlight and two or more in stronger sunlight. The apparatuses with the light filters were soon abandoned because they proved to be too heavy and unwieldy, as were the apparatuses with the blue glass plates because it proved impossible to obtain glass of a matching color. A comparison with colored solutions (copper solutions) showed that blue glass allowed more heat rays and fewer chemical rays to penetrate than the blue solution. I then tried covering the flat surface with transparent, blue-colored gelatin, but this also proved impractical. All these and other methods of achieving uniform absorption of heat rays over the entire area of the lens later proved to be quite superfluous, since it gradually became clear to me that the use of very large lenses offered no advantage

Experiments have shown that when the liquid was made very deep blue—which was necessary with large lenses because they gave off so much heat—they absorbed so many chemical rays that the advantage expected from the large lens area was actually lost, so that these large lenses often provided even less benefit than lenses of significantly smaller area, filled with a lighter solution. Experience has shown that, for this reason, at least in our latitude, it is impractical to use lenses larger than about 30 cm in diameter.

One might perhaps ask here whether it would not be better to use large lenses in order to enlarge the treatment spot in this way; this would at the same time

achieve the treatment of a larger area in a timely manner. However, this could not be done because the light outside the focal point of the lens collects too unfavorably to be of any use. If one wants to use the light within the focal point (between the lens and the focal point), one gets a disproportionately strong amount of light in the periphery of the spots and very little light in the center; if, on the other hand, one wants to use the light cone outside the focal point, one gets the exact opposite: overly strong and warm light in the center and very weak light in the periphery. This relationship can be easily and clearly confirmed by applying photographic silver chloride paper to the various points of the light cone and examining the shape of the blackened figure

I must add that I have conducted experiments collecting sunlight with a parabolic mirror made of silver instead of lenses; but I quickly gave up because the collected light was extraordinarily warm and, at the same time, relatively poorer in chemical rays. I have already mentioned (p. 8) that I also conducted comparative experiments between solar apparatuses with glass lenses and those with quartz lenses.

The result of these investigations and experiments

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1) I must note that the problem could be partially solved by manufacturing solar apparatuses with very slightly curved lenses; such a lens would provide a good focal point over a larger area. However, for the first, I have not yet succeeded in obtaining large, slightly curved glasses, and for the second, the very long focal length that such a lens would have to have would entail frequent relocation of the collecting apparatus, so that the advantage of such apparatuses would possibly be very small or even zero in practice. Experiments in this regard would be advisable if such lenses could be obtained

with the collecting apparatus mentioned here and other forms, I have provisionally settled on a collecting apparatus of the form I will now describe and which can be seen in the accompanying picture.

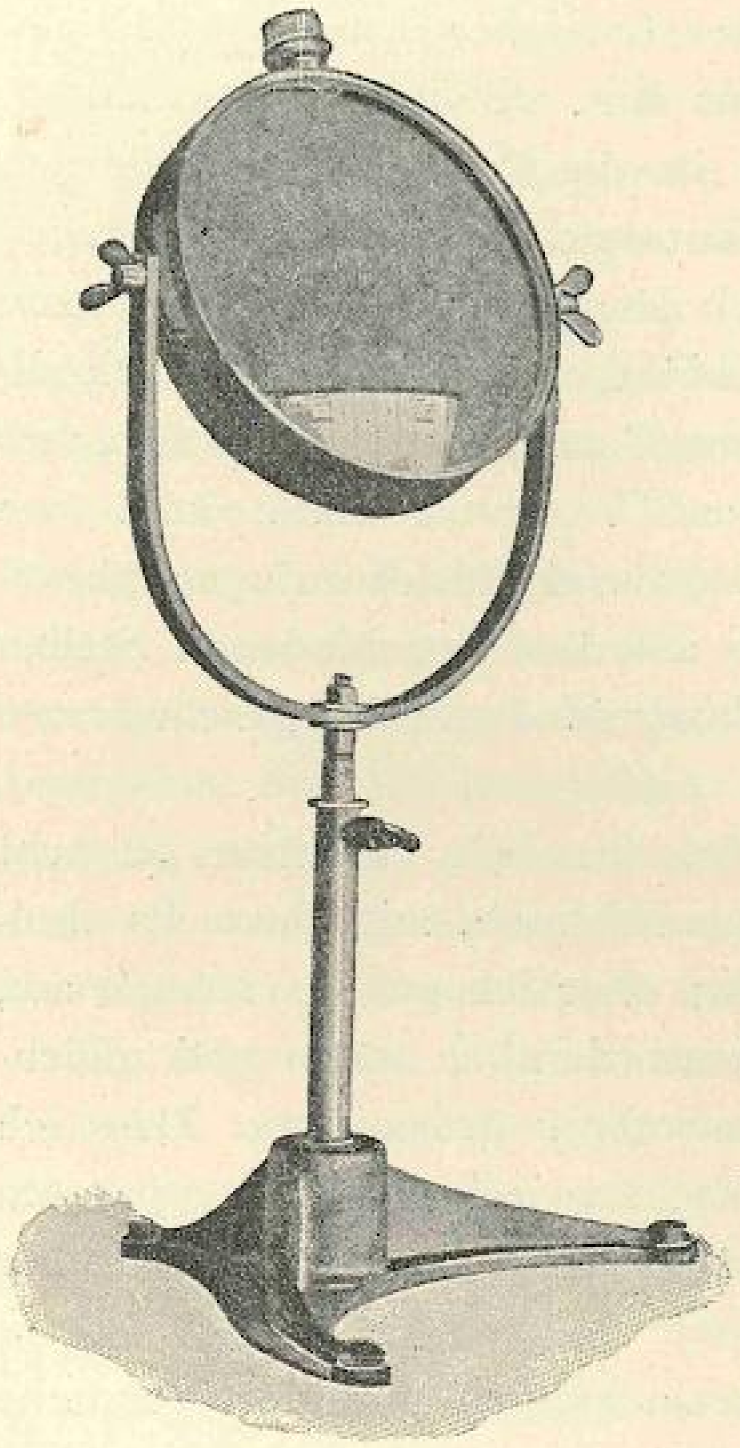

Fig. 3. 1/5 natural size.

The apparatus consists of a tripod and a lens. The tripod, which is intended to be placed on a table, carries a fork at the top, which in turn carries the collecting lens. This fork can be rotated, raised, and lowered around both a vertical and a horizontal axis, depending on whether the sun is high or low in the sky

We have convex lenses of various diameters and focal lengths; but the dimensions that I consider most favorable for Danish latitude are of approximately 25 cm, a focal length of approximately 70 cm, and a distance between the two lenses a diameter —, forming the lens of 4-5 cm at the periphery.

Whether one uses biconvex or flat-convex lenses is irrelevant; one must only ensure that the lenses are as thin as can be combined with sufficient strength.

These convex lenses are filled with distilled water, which is colored blue with an ammoniacal solution of copper sulfate, which is of course always completely clear and transparent. The strength of the solution cannot be determined precisely, as it must vary depending on the intensity of the sunlight. A solution of medium color can be considered to be 0.3 grams of cupric sulfur dissolved in 900 grams of distilled water, to which 100 grams of ammonia water (4%) has been added. If one wishes to strengthen or dilute the solution, this can be done by adding more or less copper sulfate; the amount of ammonia, however, must always be the same. A solution stronger than three times as strong as the one mentioned above should not be used, as otherwise too many chemical rays will be absorbed

despite all this, the light heats too much, which hardly ever — If, happens with a lens with a diameter of 25 cm, then instead of making the liquid bluer, one should cover a smaller or larger part of the lens segment.

I do not need to specify any limit for the descending strength of the solution, since, with regard to chemical rays, it is obviously most advantageous to have a liquid that is as little colored as possible. If the sunlight on this or that occasion heats so little that the liquid can be made completely clear, it only means that it is better to use a lens with a larger diameter and a blue-colored liquid.

In addition to these apparatuses, sun treatment also requires small tables that are firmly positioned and have a top that projects freely to the north (since the table legs make it difficult for the patient to approach).

must be, as well as with a water pipe for the pressure glasses. Since it may be of interest to those who wish to use this treatment, I will describe the sun treatment facility at this institute.

In the courtyard where the sun treatment takes place, two rows of small tables (28 in total) are set up. The tabletops, which are either round, with a half-meter diameter, or square, are supported by a stake driven into the ground. The distance between the tables is 2/3 meters. Along the rows of tables, resting in the air on 21-meter-high supports, is a water pipe. Just above each table, this pipe gives off a drainpipe equipped with a tap, from which a gutta-percha hose leads to the pressure apparatus. From this, another hose leads to a drainpipe installed beneath the table, which flows into a drain channel below on the ground This water pipe, as well as the one for treatment with electric light, caused me some difficulties at first because the water pressure was too strong. But now that I have arranged it so that the water pipe is not in direct connection with the city's water supply, but comes from a container located at a height of about 3 meters (on the floor of the treatment room), it works very well and easily. The container has an inlet pipe equipped with a float valve, so that the container is always filled with water to a certain height. In the bottom of the container are drain pipes that supply both the sun treatment water pipe and the electric light treatment. For safety reasons, the container is equipped with a drain near its upper edge.

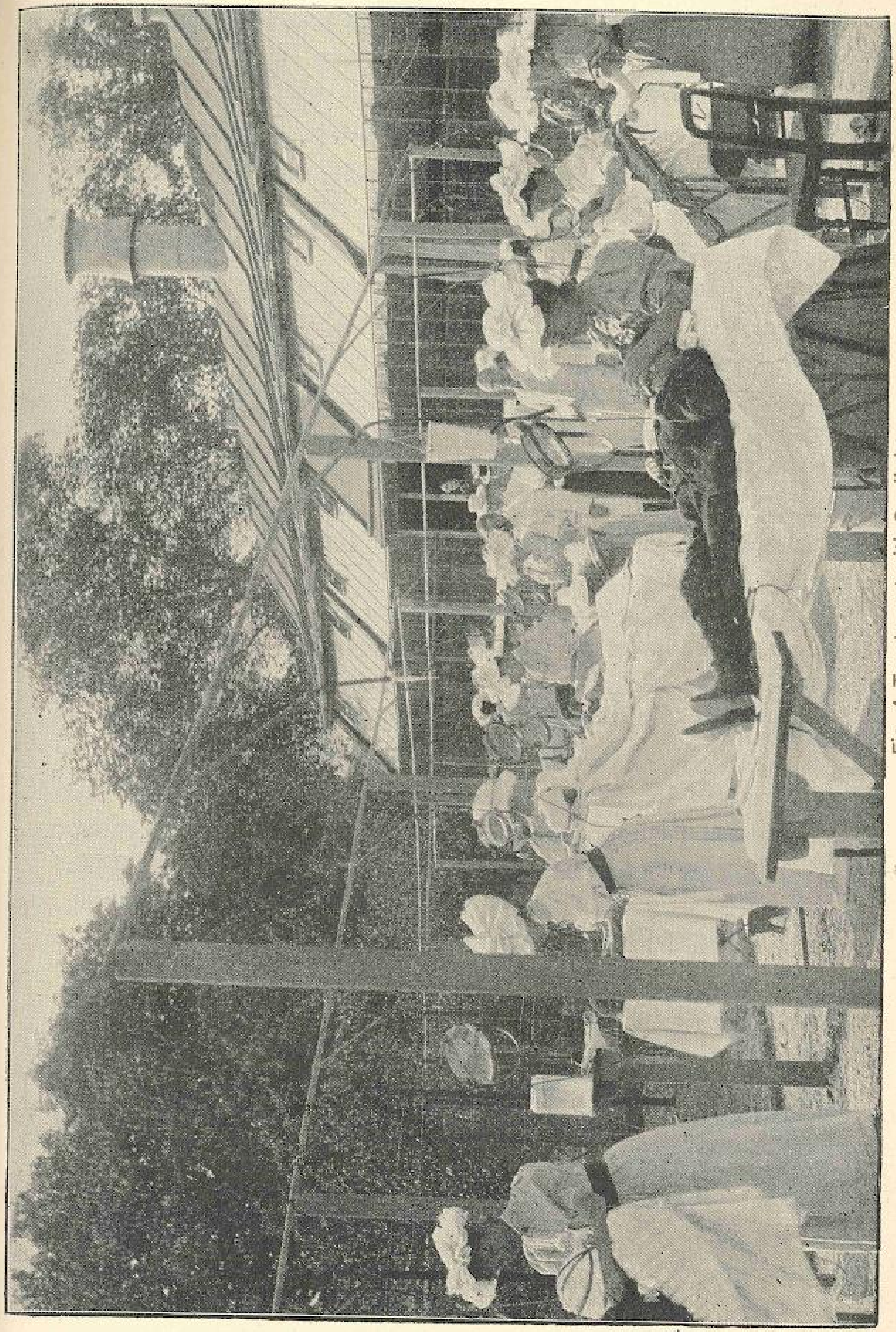

Fig. 4. Treatment with Sunlight

tube, in case the faucet or floats fail.

Collecting apparatus for electric light.

These apparatuses, like the sun-collecting apparatuses, have undergone some changes over time, but not as many as those. The most essential and significant change is that, after an experiment (mentioned on p. 5) in May 1897, I exclusively used rock crystal instead of glass lenses. But since, before this experiment, I had used glass collecting apparatuses of a somewhat different construction than those described in 1. c., p. 19, for the treatment of lupus patients for some time, and since I have not described them in any Danish treatise until now, I consider it proper to give a brief description of them

As can be seen from the accompanying drawing (Fig. 5), which shows a cross-section of such an apparatus, the difference between this and the one mentioned above is that there are two flat-convex lenses instead of three at the point facing the light, and that the water layer is bordered by two likewise flat-convex lenses. The lenses are of a significantly larger diameter (25 cm instead of 17), and the water container contains approximately 10 liters of water. While the water container in the first apparatus was filled with blue solution, in the last it was filled with clear water, while the blue solution was placed in a light filter c: a flat glass container placed in front of the lowest lens. Several such light filters with different strengths of solution were present, so that by quickly and easily replacing them, the light could be made more or less warm according to the patient's wishes.

However, we had not had these relatively good apparatuses for long before the introduction of apparatuses using rock crystal became necessary. As can be seen from the above investigations, only rock crystal and only clear water could be used with these apparatuses. The change which occurred in the

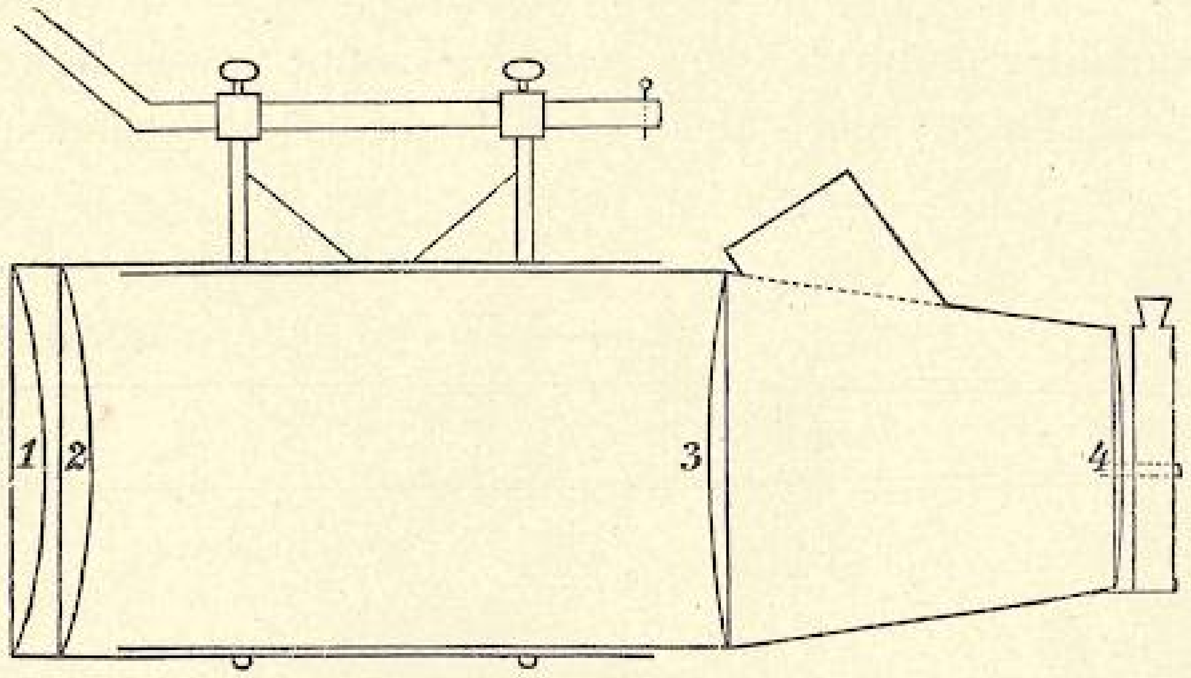

Fig. 5. 1/10 natural size

The main difference in the form now described was that the light filter was omitted, and the metal tube became significantly thinner; instead of 25 cm in diameter, it was now only 7-8 cm, because rock crystal lenses of larger diameters are difficult to obtain. This change makes the collecting apparatus currently in use (Fig. 6) resemble telescopes, a comparison that is also natural because the two metal tubes can be pulled apart and pushed into each other, just like in a telescope. While the position of the lenses relative to each other is entirely similar to the described apparatus with glass lenses, the long, thin shape of the apparatus has caused some differences. On the one hand, I was able to make the water layer very thick without any problems (approx. 35 cm), otherwise special measures must be taken to center the apparatus in relation to the light point.

Since it cannot be avoided that the light point, even if the lamp burns with a so-called fixed focal point, changes its position slightly - either due to irregular burning of the carbons or due to the lamp moving slightly - the result will be that the light is somewhat crooked in the

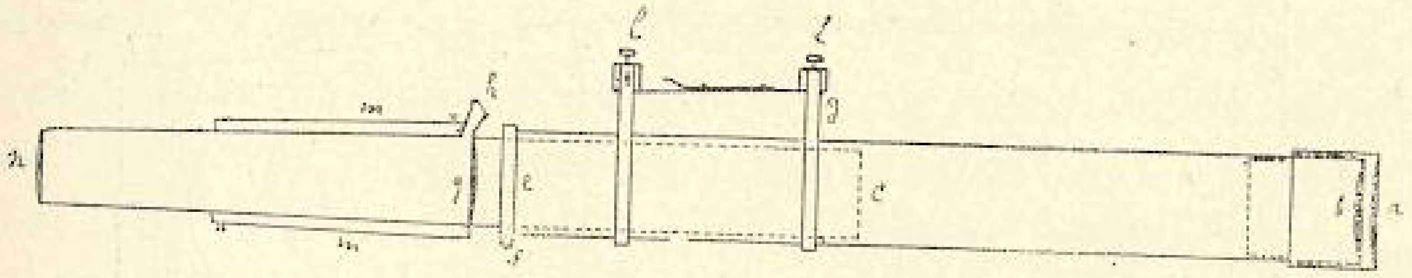

Fig. 6. 1/10 natural size

on the tube, and since the path through it is so long and the tube so thin, there is a great loss in the lowest part of the tube, falls where the light comes out. To remedy this, it is first necessary, with the help of shrouds and a so-called "wire fence stretcher," to fix the lamp as well as possible in the center of the ring that supports the four collecting apparatuses (see illustration p. 39); but then also to suspend the apparatuses so that they can be centered. This is done with the help of three screws located at the lowest suspension point of the apparatuses, while the center around which they rotate lies at the uppermost suspension point.

In the latest rock crystal apparatuses, the uppermost half of the tube, which contains water, is provided with a double wall through which cold water can be passed, and

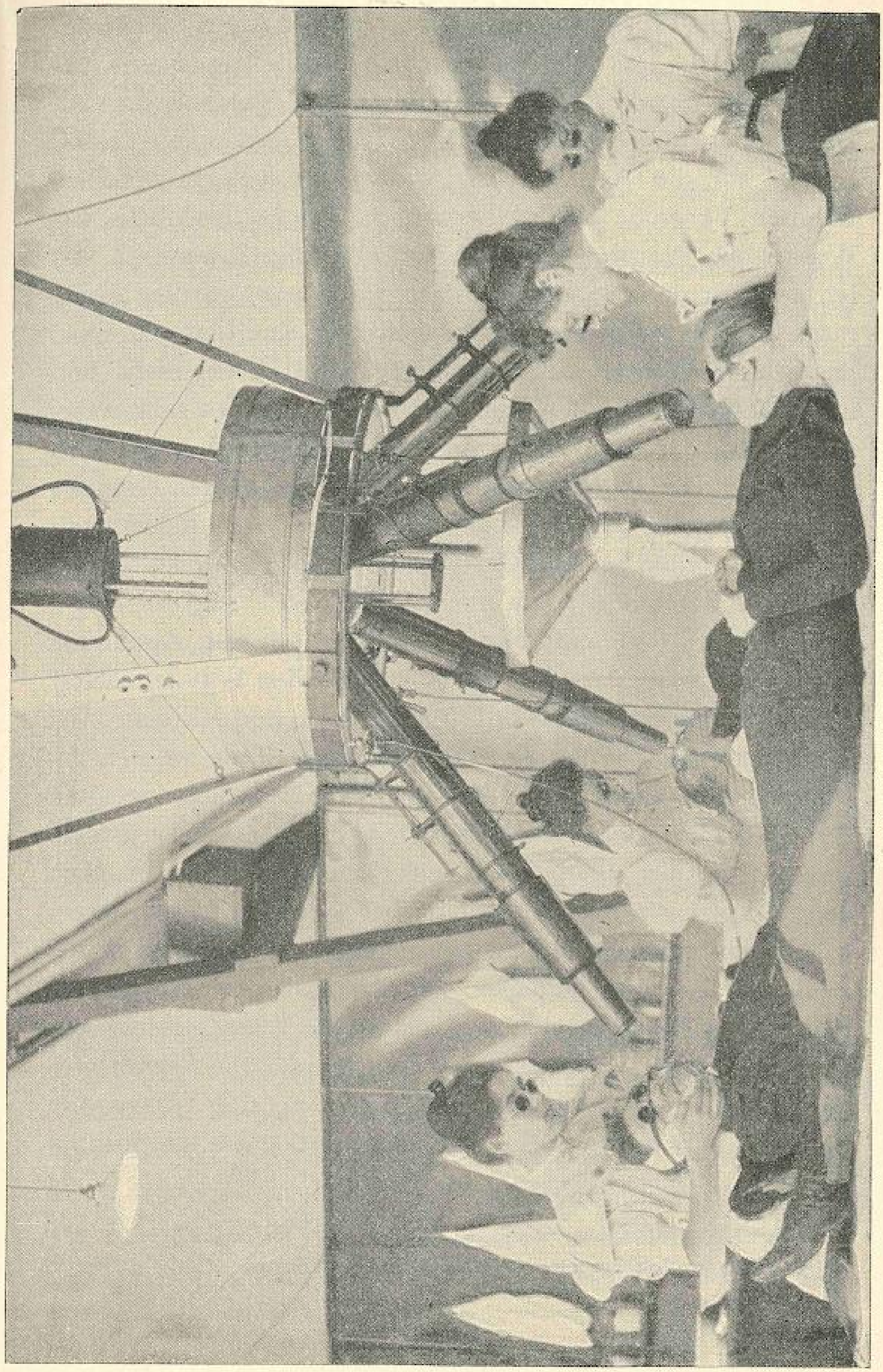

Fig. 7. Treatment with electric light

This allows the water in the container to cool without having to be replaced. The water inside the container should be distilled, while the cooling water is ordinary. The reason for attaching a so-called "cooling cap" to the apparatus is, as is clear from my above-mentioned experiments (p. 17), not that the water absorbs the heat rays better when it is cold, but rather that the water in the apparatus often becomes very warm, and as soon as a lens were to burst, the warm water would pour over the patient and possibly scald him; moreover, it is very likely that the apparatus would leak if the water became too hot. Since, for other reasons (as mentioned on p. 24), a water line had to be established for treatment, it did not require much effort to cool the collecting apparatus at the same time

The last change I made to the apparatus was that the tube forming the water container was designed so that it could be divided into two parts in the middle; the two parts are screwed together and kept watertight by a gutta-perchar ring placed between them. Even better, however, is what we have recently introduced: being able to take the tube apart at two points, directly next to the two lenses that close it.[1] This change was made to facilitate the cleaning of the inner surfaces of the rock-crystal lenses, which seal off the water layer from above and below. The necessity of very careful cleaning and frequent renewal of the water in the container was shown in a very interesting

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[1] This change was proposed at the same — but independent of me.1 — time by Professor von Petersen from St. Petersburg.

In the beginning, we only cleaned the lenses once a week, but it soon became apparent that the reaction was strongest the day after this cleaning; closer examination now revealed the necessity of frequent and careful cleaning in order to achieve the full benefit of the light.

Only very recently, I have provided the apparatus with a metal lid, which closes the lowest part of the

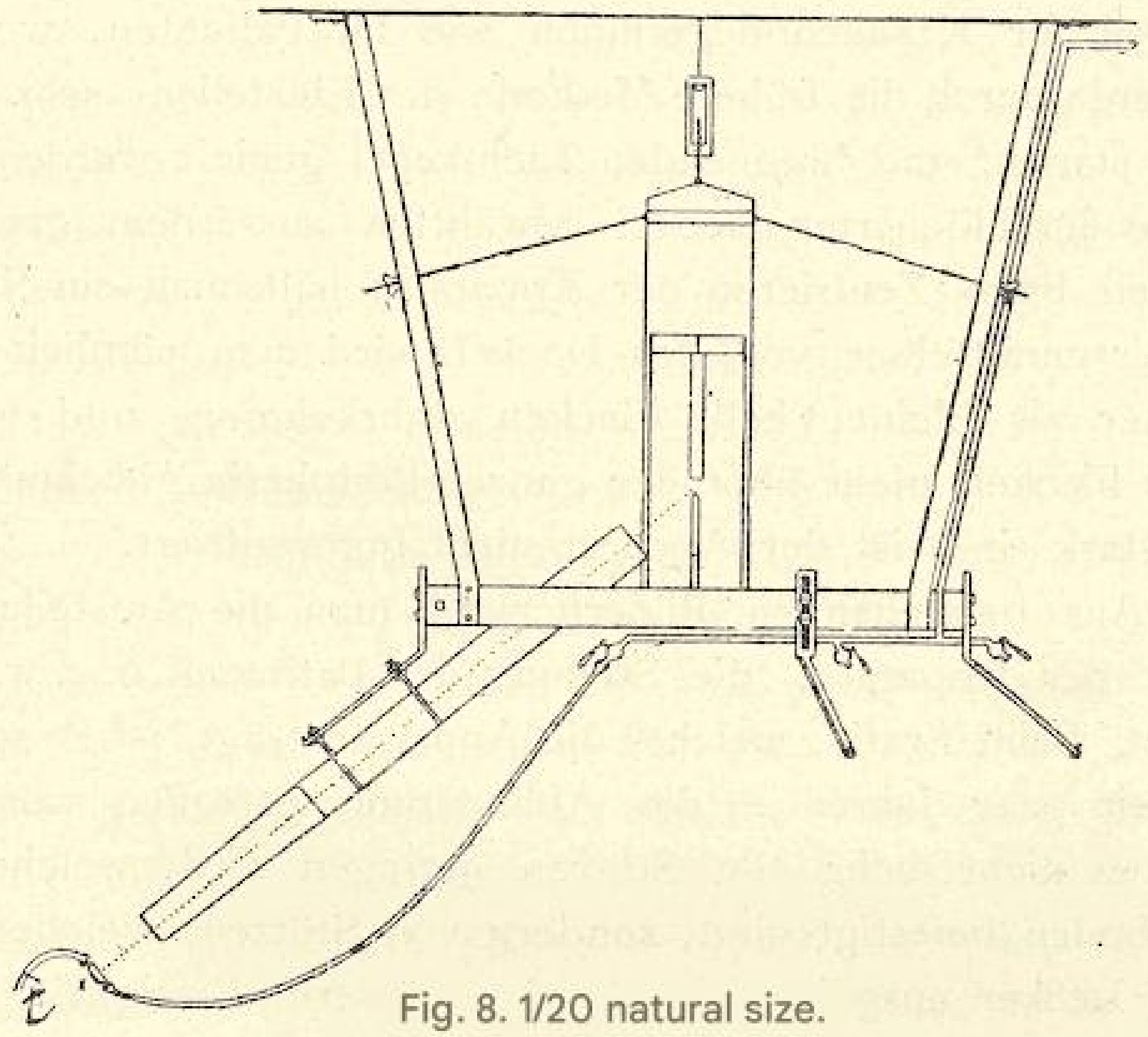

Fig. 8. 1/20 natural size.

tube, from which the light comes. The lid is similar to the one used to close a photographic camera; the only difference is that this lid is provided with a number of small holes. This lid serves to make it more convenient for the nurses to adjust the patients. Through the many small, regularly distributed holes, Minimal amounts of light, whereby the same light image (focal point) appears as usual, only very dimly, so that one can easily observe it without dark glasses. The adjustment is much easier and more accurate in this way, and only when the affected area is in the correct position relative to the light and everything is in order is the cover removed and the full, strong light now falls on the patient. However small this improvement is, it represents a very great advantage for nurses as well as for patients, the latter of whom were very embarrassed by the strong and burning cone of light with the previous method of adjustment. These perforated covers also provided a great advantage in centering the apparatus; if one holds a piece of paper directly in front of the cover, one will perceive all — the holes as small, bright spots, and if these spots are not evenly bright over the entire periphery, the apparatus is not well centered

The accompanying pictures show the arrangement of the apparatus, the position of the patients, etc. A few years ago, a modification was made to the stand that supports the apparatus: it is no longer supported by supports fixed to the floor, but by supports extending from the ceiling, thus achieving greater stability and more space for the patients and nurses.

What is the difference between sunlight and electric light, and when should one use one and when the other?

The difference between sunlight and electric arc light, which is of practical importance to us, can

be briefly expressed as follows. 1. Sunlight contains relatively more heat rays compared to chemical rays than strong electric arc — light. 2. The maximum of the chemical rays of sunlight lies in a different part of the spectrum, namely closer to the red rays, than in electric arc light

The theoretical conclusion that can be drawn from point 1 is that electric arc light is better suited for treatment than sunlight. Since the conditions and means for propagating the heat rays are the same and the same for both types of light, one will consequently obtain, with the same degree of heat at the focal point,

— a stronger chemical effect from the light cone of electric light than from the sunlight cone. The degree of heat at the focal point of the light cone is decisive when it comes to how strong light can be used for treatment. For we do not yet know of any reason that speaks against the use of even the strongest light for treatment, and before we learn such a reason, we must naturally strive to achieve higher and higher intensity levels of chemical rays. However, it must be added here that these should be the type of chemical rays that have the property necessary for therapy of being able to penetrate deeply (see this later).

While the temperature of the light cone that the patient could tolerate without water trickling through the pressure apparatus was 50°C, after the introduction of water trickling, as discussed, it rose to slightly over 200°C

With the last-mentioned degree of heat as the upper limit, one can further examine how strong light is possible. Regarding sunlight, the standard is lacking, since it varies so much at different times of the day and the season. As stated above, I would like to assume that lenses with a diameter of approximately 25 cm are the most suitable.

Regarding electric light, one can come somewhat closer to determining it. Experience has shown that with ordinary arc light (carbon electrodes) and with my collecting apparatus discussed above, light stronger than approximately 70 amps cannot be used. At 80 amps, the light cone is so hot that many patients cannot tolerate the treatment.

A more detailed comparison of these two types of light will be discussed later, together with the evaluation of various other light sources and the various treatment apparatus. I will only cite a few details here from which one can somewhat see the difference

Based on studies we conducted with bacteria, I assume that, under otherwise identical conditions, it would take a few minutes to kill the Prodigiosus in plate culture with strong sunlight, while it would only take a few seconds with electric light.

With regard to the visible effect on the skin, I cannot give precise figures; in general, I can only say that daily experience in treating patients shows that they get a much stronger skin reaction from electric light than from sunlight. One can certainly also say that sunlight does not usually cause blisters, whereas it usually

is the case with electric light (treatment time is 5.5 hours). Incidentally, with regard to this question, I refer to my treatise ("New Investigations on the Effect of Light on the Skin." Reports from Finsen's Medical Light Institute I, p. 8). This contains a comparison (p. 14) of two experiments on my arm with unconcentrated sunlight and unconcentrated electric light. The result was that the inflammation induced on my skin after three hours of exposure to sunlight (the experiment was conducted from 12 p.m. to 3 a.m. in the first half of August) was not as severe as that caused by 20 minutes of continuous exposure to electric light (80 amp lamp, 50-75 cm distance).

From what I have presented here, one will be able to form a fairly clear picture of the superiority of electric light, and yet it is strangely the case that, with regard to lupus treatment, we at the Light Institute have not gained any definite impression that the results of treatment are worse at times when more sun treatment takes place than in winter, when we do not need sunlight; on the contrary, in any case, we have previously been inclined to attribute a more favorable effect on the patient and a more favorable course of treatment to sun treatment.1) Now, insofar as this assumption is correct, we are faced with an apparent difficulty in explaining it; but only apparently, for probability suggests that another factor is at work here, which-

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1) This view, which is indeed a pure estimate, must now probably be modified somewhat

thing to consider: namely, the general condition of the patients. And it is a reliable experience that the general condition of our lupus patients is better in summer than in winter. This can be attributed partly to the same reasons that cause summer to be generally regarded as the most favorable time for patients with tuberculous diseases; but perhaps it is also due to the fact that local sun treatment is combined with exposure to the open air and sunshine and is thus a kind of general treatment in sunlight. Incidentally, one must remember that it is a general experience; we constantly hear it from our lupus patients that local affections often improve spontaneously in summer and worsen in winter. For these various reasons, one should therefore not be surprised that — One sun treatment apparently produces just as good or even better results in lupus vulgaris than the more powerful electric light The situation is quite different, however, with other skin diseases that we have treated with good success using concentrated light. In the treatment of lupus erythematosus, alopecia areata, and telangiectasias, the superiority of electric light is so evident that it would perhaps be most correct not to treat these diseases with sunlight at all. This difference in the effect on these various diseases is quite characteristic and can perhaps, with some justification, be regarded as a sign of the importance of the general condition for the improvement or cure of lupus vulgaris.[2]

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[1] It might be possible that better results could be achieved through very long sessions. [2] After writing this, I thought about whether not.

The practical consequence of this difference in the effect of the two types of light—a difference which, as will be remembered, did not exist in the early years of this method, but is a result of the introduction of rock crystal instead of glass—is, of course, that we now need sunlight much less — frequently than before. The use of sunlight is limited to the brightest part of the year (May–September) and the brightest part of the day; in general, we only use sunlight when the weather permits outdoor treatment. The fact that we do not use sunlight in winter, or generally when the sun is low in the sky, is due to the fact that sunlight when the sun is low in the sky is not only absolutely but also relatively poorer in chemical rays than when the sun is high in the sky. This is due to the atmosphere, which has the property of absorbing significantly more chemical rays than heat rays

One gets a good impression of the extent to which this is the case when one examines the tables for the intensity of the sun's rays in Copenhagen, calculated by our physical collaborator, Mr. Absalon Larsen. A few figures will show it best. If we set the value of the heat effect of the direct sun's rays on June 21 at 12 noon, it is

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This relationship could perhaps be explained in another way, and is based on the difference between the two types of light (see: The different position in the spectrum of the maximum of the chemical rays). There is a lot of — evidence - we have unfortunately not yet investigated it more closely - that the less refractable the rays are, the more easily they penetrate into the depths of the tissue. The explanation could therefore be the stronger depth effect of sunlight than of electric light.

1) Absalon Larsen: The Intensity of the Sun's Rays, Reports from Finsen's Medical Light Institute I., p. 110

at 7 p.m. 34; if we set the value of the chemical intensity at 12 p.m. on the same day at 12 p.m. at 119, it is only 5 at 7 p.m. At 12 p.m. on December 21, we have approximately the same altitude of the sun as on 7 p.m. on June 21, and the numbers are therefore approximately the same: the heat effect 33 and the chemical intensity 4.

In the beginning, and before I knew these numbers, I believed I could compensate for the low power of sunlight in winter by using larger lenses, but as I tested the chemical effect of the light cone when it was as strong (i.e., warm) as the treatment allowed, it turned out that the chemical intensity was extraordinarily low; but only after the exact tables were available could I clearly assess the conditions

Even if one did not have precise physical investigations into these relationships, one could still be convinced of them through direct observation. As is well known, the sun is red when it is near the horizon and becomes whiter and whiter the higher it rises. This shows that the red rays, the heat rays, are in such extraordinary predominance when the sun is low in the sky. Conversely, the color of the sun actually becomes more and more blue the less atmosphere the light has to pass through, so that if one could observe it from a point outside the atmosphere, its color would appear blue (Langley).

With regard to our application of light, the difference between these two types of light has the technical significance that, as discussed in detail earlier on pages 8-9, it is most advantageous to use rock-crystal lenses for collecting apparatus for electric light and glass lenses for those for sunlight.

What possibilities exist for improving the method

first communication on this method, I emphasized that there was certainly the possibility of an extraordinarily great improvement in the method, both concerning the apparatus and the light itself. Although I have explained in the foregoing that over the past six years there have been great improvements in the light — Already
source and the apparatus, especially the latter, there is — in my
no doubt that the method can still be improved and will be significantly improved. I will briefly outline the directions in which development is likely to proceed.

The improvement in light will consist in creating a light that is as rich as possible in chemical rays and as poor as possible in thermal rays

With regard to sunlight, an improvement can only consist in seeking times and places where sunlight particularly fulfills the given conditions. I touched on this question earlier (p. 47) and showed that sunlight at our latitude is only suitable for light treatment at certain times of the year and day. These conditions must, of course, be known if one wishes to use sun treatment. The location of the place is also of great importance.

We know that the atmosphere mainly absorbs chemical rays; therefore, sunlight will be much better suited for treatment in places where the air is light and pure, while places where the air is filled with dust particles and water vapor are less favorable. For these reasons, sunlight is generally stronger in the countryside than in large cities with their smoke-filled atmospheres, and even stronger in the interior of the country, where the air is comparatively dry, in contrast to the coast, where it contains significantly more water vapor

The greatest importance is attached to the altitude of the location above sea level; the higher the location, the thinner the layer of air the light must pass through, and the greater the chemical intensity of the light. Added to this is the advantage that the air temperature in high-altitude locations is not as high as that of low-altitude locations at the same latitude. Heat has great practical significance. Even here in Denmark, it is difficult enough for both nurses and patients to endure the heat in the middle of the day during sun treatment on warm summer days. The further south you go, the worse it becomes, of course. In Greece, for example, it has been shown that sun treatment must be postponed to the morning hours for this reason, while the sun is low in the sky. This, however, is disadvantageous because, as mentioned above, the chemical intensity of sunlight decreases relatively sharply when the sun is low in the sky

The disturbance caused by heat in this way is actually so great that, in practice, more favorable conditions for sun treatment exist in northern countries than in southern ones. If one could make such arrangements that nurses and patients would be protected from the sun and not suffer from the heat, while still

obtaining direct sunlight for the apparatus, it would be a different matter.

From this one can see that if it were a question of establishing a large light treatment facility or a sanatorium for lupus patients, especially in southern countries, it would be very expedient to locate them at high altitudes. Apart from the great economic importance of the use of sunlight compared to electric light, there is the advantage that, due to the great chemical intensity of the light, one could certainly achieve completely different favorable results in such a location than are possible with sunlight in our country The idea of establishing such an institution or sanatorium for skin tuberculosis on a mountain may not be so absurd at present, since sanatoriums for pulmonary tuberculosis are currently being built on mountains. Perhaps it would be most natural and easiest to combine such a lupus treatment institution with a phthisis sanatorium, since the latter might already have an electrical system for lighting. Collaboration would be easy here and could possibly even be achieved without any further electrical system, since the light treatment could take place during the day when there was no sun, since electricity is not used for lighting. At the same time, it would be a good opportunity for the not inconsiderable number of lupus patients who also suffer from pulmonary tuberculosis to be able to enjoy systematic pulmonary tuberculosis treatment. This combination of lupus treatment and phthisis treatment is already in practice at the local Light Institute, where, on Dr. Bang's initiative, we set up a lounge for lupus patients with chest disease.

at the same time, we have also strove to improve the nutritional status of the less well-off patients by distributing milk and hematin albumin. (Since the patients do not live at the institute, we could only partially concern ourselves with their nutrition.)

This suggestion of mountain lupus sanatoriums is certainly somewhat outside my subject, but may perhaps have practical interest now that so much can be done, and hopefully something will therefore be done for the unfortunate people who suffer from lupus, in the same way that is done for chest patients. And there can be no doubt that the disease is widespread enough in most countries to justify such comprehensive measures, since we have learned how widespread it is in Denmark, a country that is not particularly heavily tuberculous

But to return to my topic: the possibility of improving the light source, we are quite differently free when it comes to artificial light. Since this is of great importance, we have been working constantly on this task over the past few years. The investigations initially aimed to: 1. determine, by comparing different types of arc lamps, which was best suited for us. Accordingly, it was necessary to find out 2. whether the light from the arc or from the carbons was the best, and finally 3. at what voltage the light was most advantageous for our purpose. For this determination, we used partly chemical reagents (silver chloride and silver bromide paper) and partly bacteria. These latter are definitely the best and most practical means of determining the intensity of light, since they are precisely the most

The most bactericidal type of light is the one to be measured. Through a long series of such investigations, which I will not go into in detail, we have found that the ordinary arc lamp in the form we currently use, which was partly constructed according to our specifications, is preferable to all others we have tried.

To investigate whether the light from the arc or from the glowing, positive carbon tip is the most bactericidal, I formed an image of the arc and carbon with the help of a convex lens made of rock crystal and let it fall onto a plate culture of B. prodigiosus. The next day, the culture showed, just like a photograph, which parts of the light had the strongest effect on the plate culture. The least effect was found at the point of the arc, a somewhat stronger effect at the point of the negative carbon, but by far the strongest with the positive carbon. (This does not mean, however, that the ratio cannot be different with a different arc light.)

The voltage tests showed that the most favorable voltage for the lamp (approx. 50 volts) also produced the most bacteria-killing light.

The changes we made to the lamps are actually limited only to the external shape; for example, the distance between the side rods was made very large so that they would absorb as little light as possible. To prevent the lamp's regulating mechanism from overheating, an asbestos screen is attached over the carbons. Furthermore, the lamps are designed to be absolutely can be screwed into the center of the ring that supports the apparatus.

The reason for such a cursory discussion of these investigations is that the Light Institute has recently been working diligently on new lamps with various types of electrodes. These lamps initially seemed to promise much, but did not live up to expectations. They have since taught us that more precise investigations into the ability of individual types of rays to penetrate tissue are necessary, and that there is little point in continuing to work on lamps until this question is completely clarified. In any case, all probability indicates that the future will bring better lamps, since the lamps currently in use are constructed only for the purpose of illumination, but not with the aim of causing inflammation and killing bacteria. Once it becomes clear to the experts in this field that they must construct something new for medical use, progress will surely follow

The second way to improve the method is to improve the apparatus. I have said a lot about this previously and will therefore be brief. Although the forms we currently use have emerged from the most careful investigations, it would be presumptuous to believe that they could not be improved in some respects.

--both the solar apparatus, the electrical collecting apparatus, and the printing apparatus, but what these improvements should consist of is not so easy to say at the moment. One of the most natural improvements, on which we have been working for some time, would be to treat a larger area at once, that is to say

to arrange the apparatus and lamps so that the light spots become larger without reducing the intensity of the light. With the usual apparatus with lenses of 7 cm diameter, one would have a spot of 7 cm in diameter, instead of the current one of 1/2 cm

Diameter, if one were to place a flat plate of rock crystal in the lowest part of the tube instead of a convex lens. To achieve the same effect, the intensity of the light must, of course, be significantly increased at the same time. Such an enlargement of the light spot would be very advantageous for widespread cases, but unnecessary for less widespread ones. We will therefore probably have apparatuses with light spots of different sizes in the future, so that, as we have already arranged, one has light spots of different intensities

very practical improvement was recently made by Dr. A Reyn. Since the lens closest to the light often cracks, Dr. Reyn came up with the idea of cooling it with water. This is done by placing a flat rock crystal plate 2 cm in front of the uppermost lens. In the space created by this, there is distilled water, which is constantly cooled by a water stream circulating around it. This prevents the precious lenses from cracking, but also brings the entire apparatus closer to the light, and this can thus be better utilized.

The Application of the Method in Practice.

While I have dealt exclusively with the physical part of the method in the previous section, I will now proceed to give a description of the application of the method in practice, as well as a report on the therapeutic results achieved with its help to date.

As is clear from my first publication on this method, 1. c. 43-44, I was clear from the outset about the great potential for development that lay within it, both with regard to its technique and its therapeutic field, and although several of my assumptions and opinions turned out to be incorrect (e.g., at that time I believed I could achieve an enormous amount by using very large solar lenses, which, as mentioned above, was not the case), my hopes have not been disappointed

At that time (1896), fearing — that the method could only be judged by the relatively good results achieved at that time, I declared the following (1. c. p. 43): "A — judgment about the method from the current standpoint will therefore be entirely incorrect. Before experiments have been carried out with very strong light and the best possible apparatus, one will not be able to form a definite opinion about its real value." This raises the question of whether we are now at the point, or when we will reach the point, where we can consider the demands made to have been met. I will reply that I do not consider the method to have been even remotely fully developed before the introduction of rock-crystal apparatus and large arc lamps of 60-70 amps, which was only fully implemented in June 1898. The preceding period, i.e., from November 1895 to June 1898, must be described, as I do below, as the experimental stage

The separation of the experimental stage from the later stage takes on essential significance when the results of the treatment are discussed, while it plays no role, so to speak, with regard to the technique or execution of the treatment, which I will now discuss in more detail.

The execution of the treatment.

No very essential changes in the execution have been made, and the description I gave on 1. c. pp. 36-38 therefore still applies. The following changes have occurred

Each area is now treated for only 54 hours instead of 2 hours, and yet the effect is now much stronger than it was previously after 2 hours. This time (the 5/4 hours) is not absolute; it is the one currently used for lupus vulgaris, but it is very likely that experience will gradually show that for diseases successfully treated with this method, one can either be content with shorter séances or longer ones must be used. It may also be necessary later to individualize the duration of the séances for lupus vulgaris, since there is a significant individual difference in the intensity of the skin reaction. At present, we individualize by exposing patients, depending on their tolerance for light, to either the strongest or weakest lamps we use—70 or 45 amps, as appropriate for the purpose. They sometimes receive two applications in succession to the same area

At first, I let each nurse serve only one patient; but I hoped that later, when they were more experienced, each would be able to serve two patients

I tried it for a while, but gave it up again because it seemed to me that what was gained economically was lost again through poor maintenance. And now, after the introduction of the thin, long rock-crystal apparatus, which must be adjusted frequently, and the pressure glasses with water trickling through them, I consider it very wrong to have a nurse supervise more than one patient. In addition, the nurses can rarely leave the pressure glass entirely to the elastic band to which it is attached, but must hold it in the correct position and often exert pressure on it with their fingers, which would be impossible if the nurse in question were to attend to two patients

A greater difficulty than one might think is associated with the appropriate positioning of the patient. One might perhaps find that this point is of secondary importance and can be overlooked, but in reality, it is of great practical importance that the treatment is not burdensome for the patient. It is easy to understand how difficult it is to place the various diseased areas, especially the face and neck, under the cone of light so that the light falls fairly perpendicularly onto them and also so that the head is not simultaneously turned into an uncomfortable position. Since a séance lasts four hours, and one must keep the head in the same position during this time, it is naturally important to lie comfortably. This quick and easy positioning of the patient in a correct and comfortable position relative to the light is one of the most important, but at the same time most difficult, tasks of our nurses. The most practical method has proven to be to place the patient on a bed with adjustable

Head end shown (the shape we use in hospitals for bandaging). The finer adjustment of the head, in order to bring the affected area under the focal point of the light cone, is achieved with the help of differently shaped pillows. In many cases, when the patient can be treated most easily in a sitting position or prefers to sit, we use rocking chairs with great advantage, as they can be adjusted with the help of wooden blocks that are pushed under the aisles. One could certainly construct special chairs that would be even better and adjustable in all directions, but they would be considerably more expensive and would provide little benefit in comparison.

The effect of the treatment

Since light treatment already encompasses a considerable range of skin diseases and is constantly expanding its indications, the description of the treatment and its effects should have a general character. However, since our experience with lupus vulgaris is much greater than with all other diseases combined, I will prefer to give a detailed description of the treatment and its effects in this disease as a paradigm and add what is particularly noteworthy later when discussing the other diseases.

The treatment currently proceeds by illuminating a small, round spot (2-3 cm in diameter) for 5/4 hours daily. To ensure that the nurse does not make a mistake regarding the location and to ensure that the light cone consistently aims at exactly the same spot, the physician usually draws a with a dermatograph, a ring is drawn outside the area to be treated. Since we have the powerful rock crystal apparatus and the strong light, the same spot is generally no longer treated several days in a row as before, when there is enough diseased tissue to choose a different spot. The reaction is often so severe that it cannot be treated well. There are great individual differences here, for while some patients with lupus so small that there is only room for one spot can tolerate the treatment for many days in a row, others have to take a break of one or more days between each treatment.

visible effect of the treatment on the skin is severe reddening of the spot, and the spot rises above the surrounding skin; vesicles often, one could say almost always, form on the spot The time of its formation varies, between 16 and 24 hours after illumination. This vesicle formation, which sometimes takes on smaller, sometimes larger dimensions, is very similar to the vesicles after vesicatories. Vesicle formation occurs much more frequently and strongly after electric light than after sunlight. In individual cases, the reaction on the treated area is so severe that a slight edema occurs in the surrounding skin, especially if the area is in the The region of the eyes. Incidentally, one can usually judge from the extent of the skin reaction whether the apparatus and the light are functioning properly; if the reaction is very slight, there is reason to assume that something was wrong with the lamp or the apparatus; in this way, as mentioned above, we have learned that very frequent cleaning of the apparatus is necessary.

The reaction acquires a second practical interest in that it makes it possible to check whether the nurse had been careful or not. If, for example, the spot is very blurred, or there are possibly two red spots on the skin, this proves that the light cone was not always in the same place during the entire séance.

The further course of this skin reaction is: drying of the vesicles and formation of a scab, which falls off after a few days, after which new epidermis is seen forming over the entire area. This course is constant. Thus, the light treatment does not produce any necrosis of the skin, and no scar tissue forms or occurs as a result of the treatment; the new epidermis is formed simultaneously from the entire base of the spot where blister formation has occurred

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— In my first treatise, 1. c. p. 39, I once mentioned having observed necrosis after light treatment, which was due to a pure burn; I must add here that I later observed only a very isolated case of this. If one considers that the necrosis of the lupus tissue was intentionally induced in various previous treatments, one will not attach any detrimental significance to these individual cases, especially since they were usually caused by the patients' lack of attention, in that they did not report that the light was burning.

I will add, incidentally, that I intentionally used this ratio experimentally on several occasions. I was dealing with a few isolated lupus nodules that had been very resistant to light treatment; I therefore suggested to the patients that they try burning away the wound with the help of the light cone, that is, applying the warmth of the light simultaneously with the chemical rays. By applying strong pressure with the pressure device, the process became less painful, and the patients endured it quite easily. But the result did not meet my expectations; on the contrary, instead of disappearing, the affection seemed to spread, and when one takes into account the painful nature of the treatment and the loss of substance during wound formation, the result of these experiments was actually proof of the great advantage of "cold" light.

A significant consequence of the peculiarity of light treatment not to produce a scar and therefore also to be applied to healthy skin without disadvantage is, as I mentioned right at the beginning (1. c. p. 40), that the apparently healthy, but possibly infected area surrounding the diseased area can be treated. In this respect, light treatment has an inestimable advantage over many other methods that may otherwise be rational

Now that the affected area and the surrounding healthy edge have been thoroughly treated, a change in the affected parts becomes apparent; any ulcerations are healed, the surface becomes firm and smooth, and upon diaphanoscopic examination, it is seen that the characteristic lupus nodules become fewer and fewer, finally disappearing completely. Meanwhile, the skin remains red on the treated areas for some time, but gradually becomes pale and regains its natural color.

This process of change naturally takes a certain amount of time; how long is impossible to say, since there is such extraordinarily large individual variation

and therefore a certain amount of time must pass before one can truly see the effect of the treatment and determine whether the healing is complete or whether diseased spots still remain For this reason, to save time and unnecessary treatment, we have arranged for treatment to be discontinued for one or more months once the diseased areas have been thoroughly treated and appear to have improved significantly. During this time, a clear distinction is usually made between the healed and the not-yet-healed areas. The patient is then treated again, but this time usually for a much shorter period, followed by another break, and then possibly a new treatment, until finally nothing remains. It is not uncommon for the patient to be completely cured after the first treatment, but this usually requires several treatments. I will illustrate the situation in our case in the statistics below. It is self-evident, however, that such statistics can only be valid for a single clinic or a single doctor, since it depends greatly on how long and how thoroughly the first treatment was carried out. The statistics also show that many patients have had to resume treatment numerous times, but this is also the worst possible outcome. The treatment is as effective in lupus vulgaris as can be expected. The fact that among our more than 800 cases, there are nevertheless a few in whom the effect of the treatment was very slight can perhaps be blamed not so much on the method as on other fortuitous circumstances.

Since it was important to me to make the experiments with this new method as pure as possible right from the start, so that they excluded any doubt, I used only light treatment in the treatment of the first 130 patients. Later, in individual cases, we advantageously applied other, older treatment methods, galvanocaustic therapy, — ointment treatment (especially Pyrogallus ointment), etc., before the light treatment, and then continued and concluded with the light treatment. How frequently we used this combined treatment method is shown in the statistics below. The cases in which we used this preliminary treatment were primarily cases with thick, spongy granulation formations, with heavily pigmented, thickened lupus areas, and the like. It has been shown that such preliminary treatment significantly accelerated healing in many cases; it paved the way for the healing light treatment The cases that make light treatment difficult to manage are, naturally, partly the very thick, deep-seated affections, partly the heavily pigmented forms. I must also add that we only need these strong agents for preliminary treatment in cases where the cosmetic result cannot be influenced by them, as well as where less important than rapid healing is required (e.g., on the trunk or the extremities).

In recent years, after the introduction of rock-crystal apparatus and since the effects on the skin have become stronger and the formation of vesicles has become more frequent, we have, in order to protect these excoriations caused by the treatment, treated patients with boric water.

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1) Since the spring of 1898, patient treatment has been directed by Dr. Forch-Hammer as senior physician, with Dr. Reyn as secondary physician.

beatings, which incidentally also serve the purpose of softening the scab and thereby making the affected parts more accessible for light treatment. We also often need Diachylon and other healing ointments. 1)

(Continued.)

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1) Since the above was printed (it had been ready for some time), a number of new lamps and new apparatus have appeared. I have not been able to discuss them here, but will go into them in more detail below by comparing them with each other and with my apparatus.

On the absorption of ultraviolet rays by blue liquids. By Valdemar Bie.

As described on pages 14 and 18 in Prof. Finsen's previous treatise, he originally treated patients with electric light concentrated through glass lenses and cooled by passing through a blue, ammoniacal copper sulfate solution. Simultaneously with the introduction of rock-crystal lenses, he replaced this blue solution with water because some preliminary experiments showed that the blue liquid absorbed ultraviolet rays, thereby losing the advantage of rock-crystal lenses. These preliminary experiments have remained for the time being. Since it is naturally of great importance to know for sure whether the chemical effect of light is so reduced by passage through a blue solution that the cooled electric light is unusable in practice, I conducted some experiments at Prof. Finsen's request to investigate this relationship more closely

The light from a 25 amp, 48-50 volt arc lamp was concentrated by a Finsen concentrating apparatus with rock crystal lenses. The first lens was 7 cm in diameter and 1.5 cm from the carbon tips.

A small stand was attached to the part of the concentrating apparatus facing away from the lamp, on which the rock crystal dishes containing bacteria mentioned below were placed, and a brass plate was suspended from a suspension bracket to block the light

This concentrated light passed through a light filter made of rock crystal or glass, which was filled with either distilled water or a copper sulfate solution (12% solution to which 1 cm^3 of ammonia water was added for every 10 cm^3). Both light filters had a lumen of 25 mm. The glass plates were 2.7 mm thick, the rock crystal plates 1.7 mm. The front surface of the filter was 40 mm from the nearest lens of the concentrating apparatus. The light cone had a diameter of 25 mm at this point.

After the light had passed through the light filter, it struck previously treated bacteria in the following way: A broth culture of B. prodigiosus (15 hours old in the first experiment, 18 hours old in the second) was filtered through filter paper. 1 cm^3 of this was diluted with 9 cm^3 of water Drops of this suspension were transferred to the rock crystal plate, which was enclosed in a brass ring, so that the plate and ring together formed a dish. A drop was placed on each plate and dried in a desiccator with calcium chloride. The bacteria were then illuminated under the conditions specified above. The rock crystal plate was placed 130 mm from the nearest lens; at this point, the light cone had a diameter of 12.5 mm. During illumination, cold water continuously flowed over the side of the rock crystal plate facing the light; the bacteria were placed on the opposite side of the plate. After illumination, I covered the dried bacteria with a drop of agar. The

Finally, the dishes were placed with the bottom (rock crystal plate) facing up on moist filter paper in a Petri dish, forming a moist chamber.

By doing this, I avoided the very significant source of error represented by the absorption of chemical rays by the culture media

When a saline solution, bacterial suspension, or something similar dries, a narrow, raised rim forms around the periphery of the dried drop. If this is covered with a drop of agar, as I did in this experiment, and the bacteria are allowed to grow, the growth in this rim becomes denser than within it. If the bacteria are illuminated, those in the small area inside the rim are killed first, whereas those in the edge later. The destruction of the bacteria in this raised rim proceeds irregularly, as expected. When reading the experimental results, I therefore only considered the part of the dried drop that lies within the rim.

I. Rock crystal light filter with distilled water.

	Experiment I	Experiment II
1 sec.	Growth	
2 ,,	do.	
4 ,,	do.	Growth no
7 ,,	no growth do	growth do. do. do.
10 ,,		
15 ,,		
20 ,,		

II. Rock crystal light filter with copper sulfate solution.

	Experiment I	Experiment II
14 min.	Growth do.	
1/2 ,,		
1 yay	do.	Growth do. no
2 yay	do.	no
4 yay	no growth	growth \ do.
7 ,,		
10 ,,		do.

III. Glass light filter with water.

	Experiment I	Experiment II
1/4 Min.	growth do.	
1/2 "		growth do.
1 "		
2 "	no growth do. do.	no growth do. do.
4 "		
6 "		

IV. Glass light filter with copper sulfate solution.

	Experiment I	Experiment II
1/4 Min.	growth	
1/2 "	do.	
1 "	do.	growth do.
2 "	do.	
4 "	no growth	no growth do. do.
7 "		
10 "		

The result of the experiments is that the bacteria are killed under the given conditions

when the light has passed through rock crystal and distilled water: in 4-7 seconds;

when the light has passed through glass and distilled water: in 1-2 minutes;

when the light has passed through rock crystal and copper sulfate solution: in 2-4 minutes;

when the light has passed through glass and copper sulfate solution: in 2-4 minutes.

The significant difference I found after light passed through rock crystal with distilled water, or through glass with distilled water, is due to the absorption of ultraviolet rays by the glass. The difference between glass with distilled water and glass with copper sulfate solution is due to the absorption of blue and violet rays by the same. I found no difference between copper sulfate solution in rock crystal and in glass. In other words, a copper sulfate solution of a given strength absorbs so many chemical rays that the difference in using rock crystal instead of glass is lost as soon as the light passes through the solution.

Investigations into the effect of light on smallpox vaccine. By Niels R. Finsen and Georg Dreyer.

The great influence that light has on the course of skin affection in smallpox must arouse astonishment. First, there is reason to be amazed that ordinary daylight can have such a powerful effect that the mere exclusion of chemical rays is sufficient to prevent the appearance of one of the most terrible disease states known to us (the suppuration stage). Second, there is every reason for astonishment in our bacteriological age that precisely the exclusion of a bactericidal agent has this effect in an infectious disease. If one were to draw the following conclusion: since smallpox is an infectious disease, it should seem rational to keep patients lying in strong light, and preferably in blue light, since this has a particularly bactericidal effect, then, from a purely theoretical standpoint, one would not have much objection to this view

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Such an objection has actually also been made against the treatment of smallpox by excluding chemical rays. The English physician, Dr. Moir,

who polemicized against this treatment in The Lancet — without having tried it, bases his argument exclusively on the above conclusion. Dr. M. ended his article with the words that the motto for smallpox treatment is precisely: "light, light, more light."

Experience gained has since become more valuable than theory, and this has not proven Dr. Moir right. Incidentally, the method was by no means lacking a theoretical foundation; it only had the flaw of not entirely fitting the dominant bacteriological standpoint of the time. Its correctness is demonstrated by the numerous and consistent results achieved with red light treatment, and one must admit: in the case of smallpox, the inflammation-inducing effect of light is much more important than its bactericidal effect

There was also the possibility that the pathogens in smallpox reacted differently to the effects of light than other microorganisms; at least, some investigations2) carried out at the Vaccination Institute in Hanover seem to indicate this. These showed that as soon as animal smallpox vaccine was enclosed in capillary tubes and exposed to scattered daylight or even sunlight for 2-8 weeks, the effectiveness of the lymph nevertheless remained unchanged.

Since it seemed to us that the solution to this question was of some interest, we subjected it to further investigation.3)

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1) John Moir. Treatment of small pox by exclusion of the chemical rays of daylight. The Lancet, September 29, 1894, p. 739.

2) Medical Statistical Report, from the Imperial Health Office. Vol. 5, Issue 2, p. 94.

3) The investigations were carried out by G. Dreyer

The experimental setup.

An electric arc lamp was used as the light source, and a Finsen concentrating apparatus with rock crystal lenses was used to concentrate the light.

The diameter of the positive and negative carbons was 2.4 and 1.5 cm, respectively. The tip of the positive carbon was always at a distance of 11.5 cm from the nearest lens of the concentrating apparatus. At the beginning of each series of experiments, new carbon (of the same length) was inserted. For all experiments, the arc lamp burned at 25 amps and 49-50 volts. During the experiments, the direction of the light was always 450° to the horizontal plane, and the illuminated area was perpendicular to the direction of the beam

The animal smallpox vaccine (ordinary glycerin emulsion) used for illumination was very willingly donated to the Light Institute by the Royal Vaccination Institute, just as the institute also kindly undertook the considerable task of carrying out vaccinations with the illuminated vaccine. This is of great importance, as it requires considerable routine to achieve consistent and reliable results. We therefore request our warmest thanks from the institute and its director, Corps Physician Dr. Bondesen, for their cooperation.

The vaccine to be illuminated was applied as a drop to a flat rock crystal plate set in a brass ring using a platinum wire eyelet with a diameter of 3.5 mm. (The thickness of the platinum wire was 0.2 mm). The greatest thickness of the drop was approximately 0.4 mm in almost all test series; test series 1 and 2 (approx

0.3 mm) and 12 and 13 (approx. 0.5 mm) excepted. The drops are always placed in the middle of the rock crystal plate, on the side facing away from the light source. During illumination, the rays were applied in such a way that the center of the rock crystal plate was centrally located in a part of the light cone that contained the strongest chemical rays (tested with silver paper). The diameter of the light cone here was approximately 1.2 cm.

Under illumination, the uncovered dishes were sprinkled with cold water to eliminate the effect of heat.

Where experiments were carried out with clear, blue, or red glass to exclude certain parts of the spectrum, this was done by placing one of the aforementioned glass plates between the light source and the rock crystal plate. Both plates were sprinkled with cold water

After illumination, one child was vaccinated with each drop through three tears on the left arm. In all cases, a control vaccination was administered to the child's right arm using unilluminated vaccine from the same glass tube. The control vaccinations on the right arm (also 3 superficial tears) resulted in the development of 3 vaccine pustules (1 for each tear) of normal, typical shape and size (c: strong success), which makes these control vaccinations particularly suitable for comparison. The examination of the vaccinated children was carried out on the weekday following vaccination.

The vaccine from 12 different calves was used in the experiments. The age of the vaccine varied between 1 and 4 weeks

The same series of experiments was always carried out on the same day with the same vaccine, and the individual experiments were carried out in immediate succession. The abbreviations used in the attached tables are as follows:

3 vaccine pustules of normal size: strong success.
3 of less than normal size: moderate success.
,, 3 of small size: weak ↄ : success.
,, 3 of insignificant size: abortive
Success

Test series I: Vaccine from calf 26. Age of vaccine: 15 days. Illumination through rock crystal. Largest thickness of the drop approx. 0.3 mm. Vaccination on 9 children.

Test No	Illumination time	Child No.	Number of cracks	Vaccination result
1	1 sec.	1	3	Strong success (3 pustules)
2	2.0	2	3	2 ,, (3 ,,)
3	3.0	3	3 (3	,, ,, pustules)
4	5.0	4	3	2 (3 ,, pustules) ,,
5	10	5	3	Moderate success (3 pustules)
6	25.0	6	3	,, ,, (3
7	50	7	3	abortive success (3 pustules)
8	100	-		8 3 no success
9	200 9 3 no			

Series of Experiments II: Vaccine from calf 30. Age of vaccine: 15 days. Illumination through rock crystal. Largest thickness of the drop approx. 0.3 mm. Vaccination on 9 children.

Experiment No.	Illumination time	Child No.	Number of cracks	Result of vaccination
1	1 sec.	10	3	Strong success (3 pustules)
2	2	11	3	,, (3)
3	3	12	3	,, ,, (3)
4	5	13	3	,, (3)
5	10	14	3	Moderate success (3 pustules)
6	25	15	3	,, ,, (3)
7	50	16	3	No success
8	100 ,,	17	3	,, ,,
9	200	18	3	,, ,,

Test series III: Vaccine from calf 37. Age of vaccine: 16 days. Illumination through rock crystal. Largest thickness of the drop approx. 0.4 mm. Vaccination on 9 children.

Attempt no.	Illumination time	Child No.	Number of cracks	Vaccination result
1	50 sec.	19	3	Moderate success (2 pustules)
2	50.0	20	3	2 (1 — ,,
3	60.0	21	3	,, (3
4	60.0	22	3	
5	75.0	23	3	weak success (3) ,,)
6	75	24	3	,, (3)
7	100	25	3	abortive success (1)
8	100 ,,	26	3	(1) ,,)
9	100	27	3	,, (1)

Experiment Series IV: Vaccine from calf 37. Age of vaccine: 23 days. Illumination through rock crystal and red glass. Largest thickness of the drop approx. 0.4 mm. Vaccination of 6 children.

Ver- Experiment No.	Illumination time Rock-red crystal	glass	Child No.	Number of cracks	Result of vaccination
I	75 sec.		28	3	weak success (2 P.)
2	100 ,,		29	3	moderate success (2 P.)
3	150 ,,		30	3	weak success (2,,)
4	200 ,,		31	3	no ,,
5		15 M.	32	3	strong (3 ,, P.)
6		30 ,,	33	3	,, ,, (3 ,,)

Test Series V: Vaccine from calf 37. Age of vaccine: 16 days. Illumination through rock crystal. Greatest thickness of the drop approx. 0.4 mm. Vaccination of 2 children.

Experiment No.	Illumination ting time	Child No.	Number of cracks	Result of vaccination
	I 120 sec.	34 3		Abortive success (1 P.)
	,,	2		120 35 3 No success

Experiment Series VI: Vaccine from calf 39. Age of vaccine: 10 days. Illumination through rock crystal. Largest thickness of the drop approx. 0.4 mm. Vaccination of 4 children.

Experiment No.	Illumination time	Child No.	Number of cracks	Result of vaccination
1	100 sec.	36	3	Abortive success (1 P.)
2	100 ,,	37	3	,, ,, (1 ,,)
3	200 ,,	38	3	no success
4	200 ,,	39	3	no " ,,

Experimental series VII: Vaccine from calf 2. Age of vaccine: 16 days. Illumination through rock crystal, clear and blue glass. Largest thickness of the drop approx. 0.4 mm. Vaccination on 6 children.

In-attempt No	Illumination time Rock crystal	clear	blue glass	Child No.	Number of cracks	Result of vaccination
I	200 sec.			40	3	Abortive success (1 P.)
2	200 ,,			41	3	,, ,, (1 ,,)
3		5 M.		42	3	strong ,, (3.,)
4		10 ,,		43	3	,, ,, (3.,)
5			5 M.	44	3	,, ,, (3.,)
6			10 ,,	45	3	,, ,, (3.,)

Test Series VIII: Vaccine from calf 3. Age of vaccine: 9 days. Illumination through rock crystal, clear and blue glass. Largest thickness of the drop approx. 0.4 mm. Vaccination of 10 children.

Test	Illumination time			Child No.	Number of cracks	Vaccination result
Test No.	Rock crystal	Clear glass	Blue glass			
1	200 sec.			46	3	No success
2	200 sec.			47	3	,, ,,
3		5 M.		48	3	Strong success (3 P.)
4		5		49	3	,, ,, (3)
5		10		50	3	moderate ,, (3)
6		10		51	3	,, ,, (3)
7			5.52		3	strong ,, (3)
8			5	53	3	,, ,, (3)
9			10	54	3	moderate infection (2 points)
10			10 and	55	3	,, and (2)

Experiment series IX: Vaccine from calf 3. Age of vaccination: 16 days. Illumination through rock crystal. Largest thickness of the drop approx. 0.4 mm. Vaccination of 8 children.

Attempt No.	Illumination ting time	Child No.	An- number cracks	Vaccination result
1	125 sec.	56	3	no success
2	125	57	3	,, ,,
3	150	58	3	,, ,,
4	150	59	3	,, yay
5	175	60	3	,,
6	175	61	3	,, ,,
7	200	62	3	yay yay
8	200 ,,	63	3	,, ,,

Test series X: Vaccine from calf 4. Age of vaccine: 18 days. Illumination through rock crystal, clear and blue glass. Largest thickness of the drop approx. 0.4 mm. Vaccination of 10 children.

Test No.	Illumination time			Child No.	Number of cracks	Vaccination result
	Rock crystal	Clear glass	blue glass			
1	200 sec			64	3	no success
2	200 ,,			65	3	abortive infection (1 point)
3		15 points		66	3	weak infection (3 points)
4		15		67	3	(2 points)
5		20 and		68	3	no success
6		20		69	3	abortive infection (1 point)
7			15 M.	70	3	no success
8			15	71	3	,, ,,
9			20	72	3	yay ,,
10			20	73	3	yay ,,

Experiment Series XI: Vaccine from calf 5. Age of vaccine: 21 days. Illumination through rock crystal. Greatest thickness of the drop approx. 0.4 mm. Vaccination of 12 children.

Experiment No.	Illumination time	Child No.	Number of cracks	Result of vaccination
1	35 sec.	74	3	moderate success (2 P.)
2	50	75	3	,, (2.0)
3	65	76	3	(3.0)
4	80	77	3	,, ,, (3.0)
5	95	78	3	(3)
6	110.0	79	3	,, (2.0)
7	125 ,,	80	3	,, ,, (3 ,,)
8	140 ,,	81	3	No success
9	155 ,,	82	3	Weak success (2 P.)
10	170 ,,	83	3	,, (3,,)
11	185 ,,	84		,, 3 (2,,)
12,200 "		85	3	No success

Experiment Series XII: Vaccine from calf 10. Age of vaccine: 5 days. Illumination through rock crystal, clear and blue glass. Greatest thickness of the drop approx. 0.5 mm. Vaccination of 10 children.

Experiment No.	Illumination time			Child No.	Number of cracks	Result of vaccination
	Rock crystal	Clear glass	Blue glass			
1	200 sec.			86	3	Weak ex. (1 P.)
2	200 ,,			87	3	moderate success (1.0)
3		15 M.		88	3	strong success (3 P.)
4		15		89	3	(3.0)
5		20		90	3	moderate success (2 P.)
6		20		91	3	,, ,, (1.0)
7			15 M.	92	3	(3.0)
8			15	93	3	,, (3.0)
9			20	94	3	,, ,, (2.0)
10			(20.0)	95	3	,, (2 ,,)

Experiment Series XIII: Vaccine from calf 7. Age of vaccine: 26 days. Illumination through rock crystal, clear, blue, and red glass. Greatest thickness of the drop approx. 0.5 mm. Vaccination of 8 children.

Ver- Experiment No.	Illumination time				Child No.	Number Cracks	Result of vaccination
	Rock crystal	Clear glass	Blue glass	Red glass			
1	150 sec.				96	3	Weak. E. (3 P.)
2	200				97	3	Abortive. E. (1 P.)
3		15 M			98	3	Strong E. (3 P.)
4		20			99	3	Medium E. (1 P.)
5			15 M.		100	3	,, ,, (2)
6			20 ,,		101	3	and (3)
7				20 M.	102	3	Strong E. (3)
8				30	103	3	,, and (3)

The experimental tables show that vaccines, illuminated by rock crystal under the above-mentioned conditions, are not visibly affected by an illumination time of less than 10 seconds.

With illumination for a time of 10-100 seconds, a significant weakening, sometimes even complete destruction, occurs.

With illumination by ICO-200 seconds, very severe weakening or total destruction occurs. An illumination time of 200 seconds must be considered sufficient under the above-mentioned conditions to almost certainly lead to the total elimination of the vaccine's ability to produce vaccine pustules.

For comparison, I will only note that a Prodigiosus culture, dried onto an approximately 0.3 mm thick agar layer and thus illuminated under exactly the same conditions, was killed after 40 seconds of light exposure

experiments also show that small variations in the thickness of the illuminated layer are of great importance. Experiment series I and II therefore show the destruction of the vaccine after 100 The seconds of illumination, whereas in experiment series XII and XIII even 200 seconds of illumination caused absolutely no destruction; we find similar conditions when certain parts of the spectrum were excluded (experiment series XII and XIII).

Experiments IV, VII, VIII, X, XII, and XIII show that the destruction of the vaccine, as well as that of bacteria, is mainly due to the effect of ultraviolet rays.

However, 5 minutes of illumination through clear and blue glass, which retains a large part of the ultraviolet rays, has no demonstrable effect. Only

Illumination through clear and blue glass for 10 minutes results in attenuation, and it requires an illumination time of 15-20 minutes to produce severe attenuation or destruction.

The relationship is even clearer if the illumination takes place through dark-red glass, which retains all chemical rays, since not even 30 minutes of illumination has a demonstrable effect on the virulence of the vaccine.

The slight variations exhibited by some experiments can, of course, be explained by small differences in the experimental procedure, which are almost impossible to avoid, such as slight variations in light intensity, droplet thickness, etc.

It has not been possible to establish any difference in the effect of light on vaccines from different calves

It has often been pointed out before 1) that temperatures of 30-40°C have a weakening effect on smallpox vaccines and reduce the duration of their ability to produce pustules. Since it has now been shown here that strong light also has a very harmful effect, the same precautions must be observed when storing vaccines as with known bacteria and their toxins, and they should therefore be kept in the cold and dark (possibly in red glass).

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1) Lemoine: Compt. rend. de la Soc. de Biologie. No. 12, p. 321

On the Production of Arc Light with the Aid of Cooled Electrodes. By Sophus Bang.

Since Finsen pointed out the therapeutic application of "chemical" rays of light, a number of experiments have been carried out, both here and abroad, to produce such rays in larger quantities and more cheaply than before. These experiments have partly been based on utilizing the ordinary carbon arc light in ways other than those used by Finsen; partly, the application or production of new light sources with a greater abundance of chemical rays has been attempted. I will briefly discuss only these latter endeavors here

Since many metal spectra contain a great wealth of short-wave, and therefore strongly chemically active, rays, it is understandable that particular attention has been focused on these. As early as 1896, Finsen described an experiment he carried out in this direction following Prof. La Cour's suggestion. He used calcium to insert a mixture of lime and graphite into a bore of the positive electrode, which, as usual, consisted of carbon. The light produced in this way proved to be very rich in chemical rays; but the experimental results were not put into practical use at that time, particularly because the glass collecting apparatus used at that time made the usefulness of the produced ultraviolet rays illusory. A year later, I tried using magnesium, partly as a metal, partly in various compounds; The richness of light in ultraviolet rays can also be increased in this way, but it has never been applied in practice. Magnus Moller 1) used a zinc wick in his experiments on ultraviolet rays. Later, Strebel 2) proposed the use of aluminum oxide and silicate, as well as zirconium, in addition to the materials mentioned. He also used electrodes made of metallic cadmium, aluminum, and zinc, causing high-voltage induction sparks to jump between the poles of these metals, thereby obtaining a light extremely rich in ultraviolet rays. An experiment with mercury as the positive pole and carbon as the negative pole, using a direct current, was conducted in the winter of 1900-1901 at Finsen's Light Institute by Kjeldsen, using the mercury lamps of Arøn and Hewitt as a starting point. This method also produced a light extraordinarily rich in ultraviolet rays.

One metal that should be particularly interesting to experiment with due to its richness of spectral lines is iron. This was discovered in an electric lamp for therapeutic use by the Russian physician

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1) "On the Application of Concentrated Chemical Rays in Medicine", p. 46.

1) MAGNUS MÖLLER: The Influence of Light on the Skin etc., Stuttgart 1900.

2) Deutsche med. Wochenschrift, Nos. 5-6, 1901

EWALD[1]), who in 1895 believed he had made the observation that the workers in the ironworks in Kolomna (Moscow Government), who were engaged in welding iron together using electric current, were spared from certain illnesses, such as rheumatism. He therefore manufactured a lamp whose positive pole consisted of cast iron and whose negative pole consisted of a carbon rod: 2-300 amps. Kosloffski later used EWALD's lamp at a private clinic in St. Petersburg. The patients had to be placed at a distance of 1.5 meters from the arc, since the radiation from the molten iron was unbearable at shorter distances. A current of The parts of the patient that were not to be treated were protected by screens. The séances lasted from 3/4 to 2 minutes and resulted in skin erythema

The use of metals as high-current electrodes is now associated with practical difficulties, as the metal melts and splashes, so the patient must be placed at a great distance from the light source. This also makes lamp regulation more difficult. In May 1901, I came up with the idea of cooling the electrodes with water to eliminate these disadvantages. I had acquired an X-ray lamp with a water-cooled anticathode for use in the Light Institute; it now seemed logical to also try water-cooling the conventional direct-current electrodes. By forming an arc between two iron tubes through which water flows, it was shown that a steadily burning arc light with the properties mentioned below could be obtained.

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[1]) See Kernig: Experiences on the Effects of Intensive Electric Light. Journal of Dietary and Physical Therapy, 1899, Vol. 2, p. 238

Incidentally, a closer examination of the literature revealed that W. Siemens had already used a water-cooled metal electrode in an arc lamp in 1879. While the positive pole was made of carbon, the negative pole was formed from a gilded metal capsule, the interior of which was cooled by a water stream. This resulted in only minimal wear on the electrodes, which was necessary for the regulation mechanism of the lamp in question; however, a change in the properties of the light through this cooling was not observed. As I will discuss in more detail later, it is also particularly when the positive electrode is cooled that the light changes its character

The cooling of the electrodes can be accomplished in several different ways. For lower currents (under 20 amps), I have generally preferred internal cooling by giving the metal in question the shape of a sleeve that can be screwed onto a double-walled tube with water circulation. For higher currents, it is more practical, at least for the positive pole, to use external cooling by placing the electrodes in a vessel containing flowing water so that only their tips protrude above the water. In individual cases, it is advantageous to place the electrode tips just at the water surface, or even a millimeter below it, which changes the spectral character of the light but does not prevent arc formation. Under all circumstances, the coolant must act on the electrodes very close to the pole faces; for iron, the distance should not exceed 3 mm; for metals with better thermal conductivity, it can be somewhat larger

The most striking effect of cooling, as far as the positive electrodes are concerned, is observed through the suppression, or at least through a minimized, "crater formation." This is clearly seen when cooled carbon is used. Due to the suppression of the thermal transition effect at the positive pole surface, the carbon becomes convex instead of crater-shaped, but with small, flat facets, as evidence of some local action of the current at the point where the arc emanates from the pole. If cooled iron is used as the positive pole, the metal is worn away relatively slowly, disappearing in the form of iron oxide; this disappearance occurs so slowly, however, that automatic regulation of the arc length could be omitted in the forms of lamps based on this principle that have been tried so far. If poles made of less easily oxidized metals, such as silver, are used, the pole is consumed only extremely slowly

The relatively low thermal radiation is related to the fact that crater formation is so greatly reduced. At currents of up to 10-12 amps, one can touch the electrode a few millimeters from the arc without feeling pain, and one can hold one's hand a short distance from the arc for a long time without feeling any pain. At a distance of 5 cm from an 8 amp iron lamp, a blackened thermometer did not rise above 400 in repeated experiments. In an ordinary carbon arc light, the majority of both the luminous and the warming rays emanate from the crater; this light is therefore, in reality, largely an "incandescent light." The light emitted by the cooled metal electrodes, on the other hand, is predominantly true arc light.

because the electrodes only glow on the relatively small areas where the arc emanates from them. As a result, the character of the light is predominantly determined by the respective vapor spectrum of the electrode metal.

Up to now, I have mostly investigated the light from cooled iron electrodes. Since the iron spectrum is so rich in ultraviolet lines, this circumstance determines both the properties of the light and its application. The properties that are of most interest when it comes to using it to treat skin diseases are its skin-irritating and bactericidal ability, as well as how deeply it can penetrate the tissue. As far as the ability of iron light to provoke a light reaction on the skin is concerned, this reaction is extraordinarily great. A few minutes at a distance of 1 m from a 25 amp iron lamp can provoke a light erythema in the facial skin. If the skin of the volar side of the forearm is exposed, for example, If, for example, the patient is exposed to this light for 10 seconds at a distance of 12 cm, an erythema develops, which is characterized as light erythema in that it only appears several hours after treatment and leaves behind pigmentation. The bactericidal properties of the light are proportional to this. While an ordinary carbon arc lamp of 30 amps and 50 volts at the most favorable radiation angle kills Staph. pyog. aur. in a surface culture in 3 to 42 minutes, a corresponding effect is achieved with a 25 amp iron lamp in about 5 seconds (the time is determined by illuminating a suitable section in a rapidly rotating disk).

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1) This is referred to as the "relative" killing limit. See the following article

A peculiarity of ultraviolet rays is that they are so strongly absorbed by all substances, and on the whole, the further they are located in the ultraviolet part of the spectrum, the more strongly they absorb them. At wavelengths below 2,200, even water, and indeed air, absorbs them strongly. Glass is only somewhat permeable to that part of the ultraviolet rays which lie closest to the violet part of the spectrum. In agreement with this, it has been shown that an ordinary, approximately 2 mm thick microscope slide completely protects the skin against the effects of iron light, which, without the glass, would have produced a strong reaction with blistering. Ultraviolet rays penetrate the skin even more difficultly. Strebel found that concentrated light could not pass through a human ear compressed between quartz plates In another experiment, a piece of skin, prepared free of fat, was clamped between two quartz plates and "irradiated, excluding all color rays, with concentrated ultraviolet light delivered by induction sparks between zinc and aluminum electrodes." The irradiated object was 140 cm from the spark; a weak but very distinct light appeared on a fluorescent screen placed behind the skin. FREUND1 investigated the absorption conditions in the epidermis by placing pieces of burn blisters, pemphigus blisters, and Thiersch's epidermal strips in front of the 0.2 mm wide slit of a Rowland grating spectroscope. As a light source, he used the spark of a powerful Ruhmkorff inductor with electrodes of Eder's alloy (lead,

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1) Archiv für Derm. und Syph. Heft 1, 1901

zinc and cadmium) at a distance of 40 cm from the slit. FREUND came to the same result with regard to all three preparations; he found that beyond the cadmium line, y = 3250 A.E., ultraviolet light, after a 15-minute illumination period, did not penetrate the epidermis pieces in sufficient quantity to be able to act on a photographic plate; as far as the larger wavelengths were concerned, however, a certain amount of light did pass through.

These experiments, interesting in and of themselves, do not provide any quantitative clarification, since, among other things, one would have to know the energy distribution within the spectrum in question; but one can still draw the already probable conclusion that the ultraviolet rays closest to the violet ones penetrate the epidermis relatively better than those further in the ultraviolet range

In order to obtain a preliminary idea of the distribution of the bactericidal rays in the spectrum of iron, I passed the light from a 25 amp iron lamp through a spectral apparatus with lenses and prisms made of quartz. Since the spectrum thus formed lies in a line that forms a very acute angle with the rays emerging from the prism, I renounced examining the spectrum at the point where it was completely pure, but placed a surface culture of B. prodigiosus vertically to the direction of the rays, at a suitable distance behind the prism, where the spectrum was sufficiently differentiated for my purpose. At this point, the spectrum had a visible extent of 10 mm, while the ultraviolet, collected by a uranium glass, had a length of approximately 50 mm. It was now shown that with an illumination of 3-4 minutes, the bacteria in a 6-7 mm wide strip, the center of which lay approximately 15 mm outside the outermost visible violet band, while no effect was visible in the entire visible band of the spectrum and the next 10 mm of the ultraviolet band. With an illumination time three times as long, the bacteria were killed or weakened over an extension of 40 mm in the ultraviolet spectrum; but even with this illumination, they were not affected in the entire visible spectrum and in the part of the ultraviolet band immediately adjacent to it. The rays that act most strongly on silver chloride paper, as well as those that produce the strongest fluorescence in uranium glass, were distributed in a similar way. Presumably, the agreement between these ratios is due to a corresponding distribution of the amount of energy in the short-wave part of the spectrum, but this can only be determined with the help of bolometric investigations

However, this much is already clear from the experiments: the rays of iron light, which have the strongest effect on bacteria, lie quite far outward in the ultraviolet. This is in good agreement with the fact that the active components of iron light are subject to very strong absorption by the skin. Through a 1 mm thick, fat-free layer of skin (taken from the chest of an approximately twelve-year-old child), the light from a 25 amp iron lamp acts on silver chloride paper three times more slowly than is the case with a 25 amp carbon arc lamp at the same distance and under otherwise identical conditions. It is probably also the visible rays contained in the iron arc light that caused the slight blackening of the paper, which occurred gradually. Through a 0.1 mm thick layer of the same skin on the epidermis side (microtome section of a frozen preparates), on the other hand, the silver paper was exposed to both types of light at the same speed; this thin layer was evidently able to penetrate some of the ultraviolet rays. That they are able to penetrate the epidermis is also evident from the strong vascular dilation they produce.

The characteristics of iron light, as far as we know them so far, are as follows: relatively low heat radiation, strong skin-irritating effect, strong bactericidal effect, very low penetrating power. One possibility for the clinical application of this light is apparently linked to these characteristics. Where a superficial bactericidal and skin-irritating effect is desired, a good field of action must be found; it is not suitable for all deep-seated illnesses, such as lupus vulgaris

For preliminary clinical experiments, I have manufactured a small hand lamp of 8-10 amps and 40 volts. It is intended to be applied in its entirety to the affected area, so that the arc is a few centimeters from the skin. It is equipped with Finsen quartz crystals. The small thimble-shaped iron electrodes must be replaced after the lamp has been burning for 3-4 hours, as they gradually oxidize and disappear as iron oxide smoke. A disadvantage is the occasional precipitation of smoke onto the quartz crystals, which must therefore be dried frequently. With this lamp, one can elicit a typical light reaction with blistering after 3-5 minutes of illumination. Nothing definite can be said at present about the duration of any therapeutic séances; just as little specific indications for their use can be established

A direct comparison between the reactions produced by this small lamp and those resulting from the use of Finsen's apparatus would be misleading; for, since the light from the latter contains a large number of rays that penetrate deeply, the difference in the reactions after the use of the two types of apparatus is not only quantitative but qualitative. The hand lamp should presumably be considered from the point of view that, where an intensive but superficial effect is desired, it achieves such an effect in a considerably cheaper manner than has been possible up to now; where a deep effect is necessary, it should not be used at all.

On the Effects of Light on Microbes. II. An Improved Method of Investigation. By

Sophus

Bang

In an earlier work, 1) I drew attention to the necessity, in investigations into the bactericidal effect of light, of taking into account that the nutrient media in which the bacteria are located during illumination absorb a substantial portion of the applied light. The Buchner method, improved by Finsen, is the most accurate of those used to date. Meanwhile, if the killing time of the bacteria is to be determined precisely, the objection can be raised against this method that it illuminates the bacteria distributed in a layer of agar, namely as a suspended culture. Under these conditions, the bacteria lying in the depths of the agar are not struck by the light until it has been filtered through a more or less thick layer of agar, which, like most other nutrient media, due to its yellowish color and other spectroscopic properties, absorbs short-wave rays to a particularly high degree, precisely those which are most effective against microbes. Small

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1) S. BANG: On the Effects of Light on Microbes I., Reports from Finsen's Medical Light Institute II.

Changes in the thickness of the nutrient substance, its color, and other properties can therefore influence the time the light must act to kill the bacteria. In order to reduce this unpredictable light absorption as much as possible, I used "hanging drops" with a maximum thickness of 0.05–0.15 mm in the aforementioned work. The light absorption of the nutrient medium was not completely eliminated by this, but was nevertheless reduced to a relatively low value, just as a uniform effect of the surrounding air was also made possible. By also taking a number of other physical factors into account, it was possible to achieve reasonably consistent experimental results, which was difficult using the older methods. It was also shown that the bacteria were killed in a much shorter time than one would have expected from the earlier results. This is easily understandable, since the microbes lying in the depths of a light-absorbing agar layer can withstand longer illumination than those closest to the surface

Dr. V. BIE went a step further toward eliminating the light absorption of the nutrient by using "surface cultures" on agar, prepared by spreading a few drops of the bacterial culture in question onto an agar plate poured into a Petri dish. Using a desiccator with calcium chloride and air dilution, the culture fluid dries into a uniform layer. When the surface prepared in this way is now exposed to light, the light does not have to pass through any foreign substances of any significance before it encounters the bodies of the bacteria.

Since this method is somewhat cumbersome

and since such a vigorous drying process is hardly without affecting the vitality of all bacteria, I simplified the method by spreading the bacterial culture as evenly as possible on the agar plate with the help of a fine cotton brush (an iron wire wound with fine hydrophilic cotton, sterilized in a test tube), which was then left to dry spontaneously. My assistant, Dr. Jansen, later used a platinum loop instead of a cotton brush; this partly made it possible to know to some extent how large a quantity of culture had been sown, and partly because the surface dried even faster, after only 2-3 minutes By "drying out" we mean only that there is no free, mobile liquid on the surface; as for the agar itself, it retains its moist consistency and is kept in a moisture-saturated atmosphere during and after the experiment (see below). The possibility that this method may have some influence on the resistance of the bacteria cannot be completely denied, especially when it comes to species that are particularly sensitive to drying out. But as long as no experiment is carried out with such species, and as long as only comparative experiments are carried out with one and the same bacterial species, this circumstance does not come to play any demonstrable role.

That the bacteria really remain on the surface of the agar without penetrating it can be partially convinced when they have later grown to such an extent that the colonies become visible to the naked eye, which in every single case, as far as the bacteria examined so far are concerned, are completely superficial keep it superficial; in part, with regard to the tubercle bacilli, I was directly convinced by hardening a plate seeded in this way and by making a vertical microtome section through it that the bacilli lay in a thin, flat layer on the surface, without being able to see any bacillus penetrating the surface of the agar layer.

The illumination of the surface culture can be carried out in various ways; the use of stepwise illumination is practical and particularly time-saving This method was used in 1893 by Ward[1], who illuminated the suspended culture in agar through square or circular "windows" that were covered one after the other during illumination. Finsen used a similar method, independently of Ward, in his first experiments on the bactericidal effects of light,2 using, in addition to the method published at that time, the following, which he himself describes as follows: "The plate cultures in a Nielsen flask are exposed to light in such a way that after one minute, a small field of the plate culture is covered with a piece of paper, after 2 minutes a new field, after 3 minutes a third field, and so on. The pieces of paper, glued with fish glue, were black on the side facing the flask to prevent light penetration, and white on the side facing the light to prevent any heating effect. The number was written on the white side to indicate the time.

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1) Marshall WARD: Further experiments on the action of light on Bacillus anthracis and on the Bacteria of the Thames. Proc. of the Royal Soc. of London, Vol. LVI, 1894.

2) FINSEN: On the application of concentrated chemical light rays in medicine. 1896, pp. 28-32.

to indicate the time during which the field in question had been exposed to the light. When the bacteria grew and the pieces of paper were removed, a mosaic appeared, caused by the different effects on the various fields, and one could then determine how long the light had taken to kill the bacteria. Later, the method was modified so that the entire bottle was covered with the same type of paper, in which a number of round holes had been cut. After the bottle had been exposed to the light, the holes were then covered one after the other and at specific intervals. This made the effect of the light more pronounced, as each field was now surrounded by a culture completely unaffected by the light, while the surroundings thus simultaneously served as a control. These methods are used with unconcentrated light

I combined the use of step-wise illumination with the use of the aforementioned surface culture by gradually moving a flat "shadow" past the cultures at specific time intervals. Instead of illuminating one preparation for 1 minute and a second preparation for 2 minutes, as is probably usually done, I illuminate a larger area of the surface culture for 1 minute, then move the shadow one step forward, protecting a corresponding strip of the culture from the light. After one minute, I move a new step forward, so that now a total of 2 strips are in the dark, and so on. While the first method of use, to determine the effect of 1-10 minutes of illumination, requires an illumination time of 1 + 2 + 3... + 10 minutes - 50 minutes in addition to the preparations for the individual experiments, the same investigation lasts

The second method takes only 10 minutes in total, and only the preparations required for an experiment are necessary. In addition, it is of course easier to keep the light source constant for 10 minutes instead of 55.

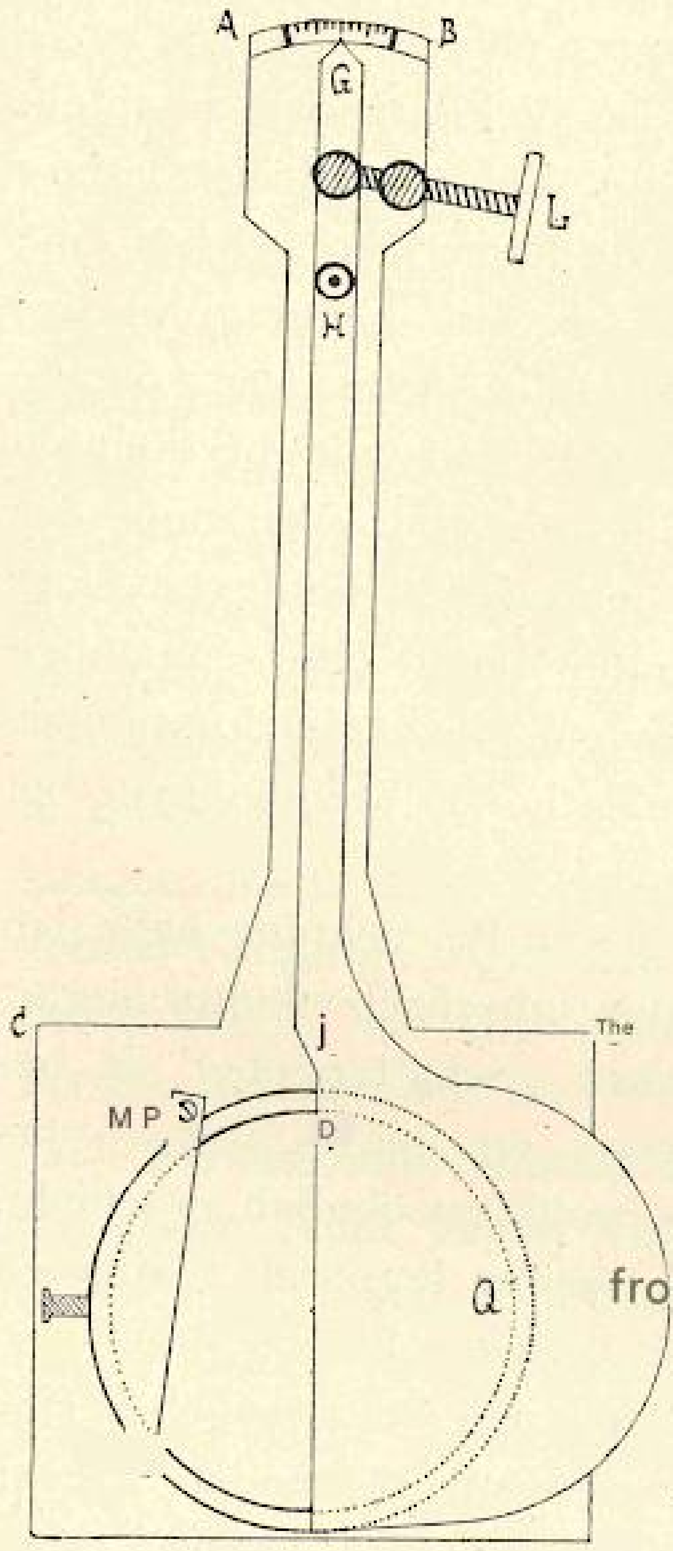

Fig. 9.

following schematic drawing shows the arrangement of the apparatus in which the illumination takes place. The brass plate ABCDEF has a circular cutout MNOQP, which is closed with a plane-parallel quartz disk, behind which the surface culture is placed. The shadow generator OKF consists of a thin brass plate with a long stem FG, which can be rotated around the pin H with the help of the screw L. In this way, the shadow generator is advanced such that its edge OP moves to the right or to the left, with the quartz disk R immediately in front. The amount of advance is read with the help of the pointer Gab. When the shadow generator is advanced as far to the left as it can, the edge OP touches the small plate MN, which constantly shades part of the quartz disk; the corresponding part of the culture thus serves for control. R U NO O E F

Even when the shader is pushed as far as possible to the right, it still shades part of the quartz disk at O, also for control purposes. At U is a tube through which types of air, whose effect is to be investigated, can be introduced into the surface of the culture (a similar tube is located outside Q).

Figure 10 shows a vertical sagittal section through the lowest part of the apparatus. TT is the brass plate on which the entire apparatus is mounted. SS is the shader. At X, the quartz plate is visible. VV is a circular dish in which the agar plate (y) seeded with surface culture rests on a glass plate. At UU, one can see the tubes through which various types of air can possibly be introduced. Culture dish VV is screwed into the apparatus and is provided with a rubber ring (g) to ensure an airtight and watertight seal. The

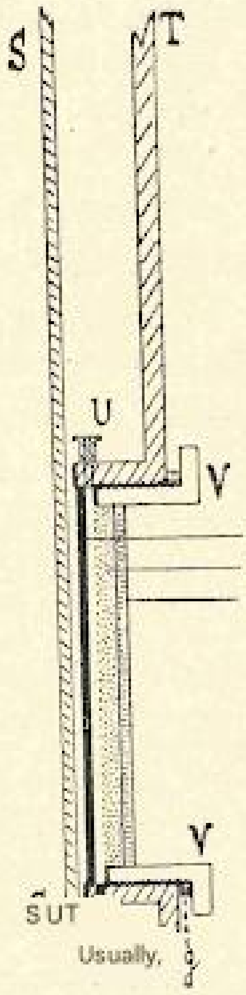

Fig. 10

the entire apparatus is mounted in a "photocteinometer" of the construction explained in my above-cited work. Since I have made a slight modification to it in a special respect, I give a sketch of it in Fig. 11, referring for details to the cited description. The sheet metal box ABCDE is placed in front of a light source in such a way that the light rays strike its surface at a right angle (if it is an ordinary electric arc lamp, it is best to place the container at an angle of 50° with the axis of the carbons). The container is, under ordinary conditions, filled with boiled, distilled water, which is kept at a constant temperature by means of the water-flowing lead pipes RR and the stirrer P. The shade HHH is placed in the sconces FF. The light penetrates the container through the glass plate MN, passes through the plane-parallel liquid layer between this and HH, and finally reaches the surface culture through the quartz plate X (see also Fig. 10).

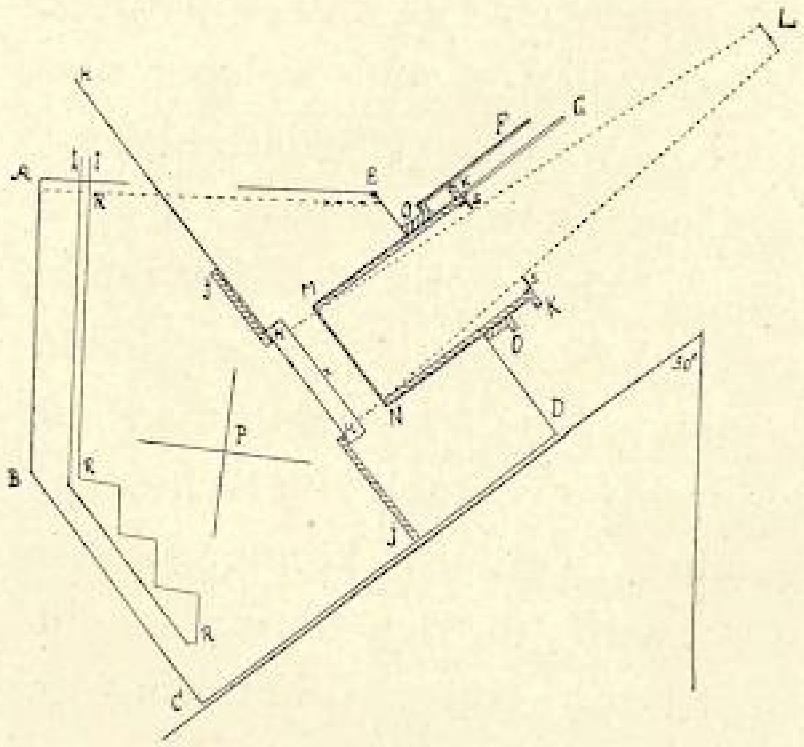

Fig. 11

The only obstacle the light beam encounters on its path from the light source to the bacteria, apart from the air, is the two flat quartz plates and the flat liquid lying between them. In order to be able to vary their thickness in a specific way, the foremost quartz disc, MN, is attached to one end of a tube KNMK, which can be screwed in and out of the ring OO. The thickness of the liquid can be read off the measuring rod F. If necessary, a diaphragm can be used with SS to prevent the light from being reflected from the sides of the tube, which, like everything else inside the container, is matt

black. The lid G is opened and closed to the light.

In order to possibly compare different test results with a common standard, I have provisionally and purely arbitrarily established the following experimental conditions as a "standard experiment."

As a light source, I used a 30-amp, 50-volt electric arc lamp; using switchable incandescent lamps, I regulated the current with an accuracy of 0.1 amp. The positive carbon has a diameter of 24 mm, the negative one 15 mm. (One of the difficulties in reproducing the same luminous intensity using such a lamp is that the nature of the carbon can vary.) By projecting images of the arc in different directions, one ensures that the crater burns with a regular shape. The photocteinometer is positioned so that the rays striking the center of the quartz window form an angle of 50° with the axis of the carbon. The distance between the nearest point on the crater and the surface culture is 60.5 cm, which corresponds to a distance of 60 cm without a water layer, since this is 2 cm thick. 1)

As test bacteria, I have so far used Staphylococcus pyogenes aureus in a 20-hour broth culture, grown at 37°C. They were filtered through ordinary, sterile filter paper and then diluted with 2 parts sterile broth. A suitable amount of the diluted broth, which has a cloudy appearance to the naked eye, was transferred, in the manner described, using a cotton brush or a platinum loop, to the surface of a sterile agar plate, which had preferably been poured into the culture dish a few hours beforehand. As soon as the liquid layer has dried sufficiently, the dish is screwed into the shade-providing apparatus, and this is placed in a "photocteinometer," which should ideally contain a liquid of at least 280, which most reliably prevents fogging of the quartz disks After the gradual illumination has taken place, the removed culture dish is placed in a Petri dish lined with moist filter paper, which is then placed in a thermostat, preferably at approximately 34°C, at which temperature it is easiest to avoid so much condensation that it can drip from the lid of the Petri dish onto the surface culture.

After standing for 24 hours, the culture has an appearance such as Fig. 12, which is reproduced from a photograph.

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1) See the cited work, p. 16

On the right and left, one sees two crescent-shaped sections with strong, confluent bacterial growth; these are the unilluminated control sections; between these sections, 10 strips received 1-10 minutes of illumination, respectively. To easily read the position of these stripes, a glass plate, on which the graduations corresponding to the individual stages of the shadow generator are drawn, is held in front of the surface culture. The strip furthest to the left was exposed to one minute of illumination. A weak light effect is already evident here in that the strip can be distinguished from its surroundings at all; an even somewhat stronger effect is evident in the next strip, which received 2 minutes of illumination. In the third strip (3 minutes of light), one sees a clear reduction, and in the fourth strip (4 minutes of light), the number of colonies is so small that one can count the individual colonies (approx. 50). In the sixth, there are 2 colonies, in the seventh 5, in the eighth 4, in the ninth 4, and the next strip, which was

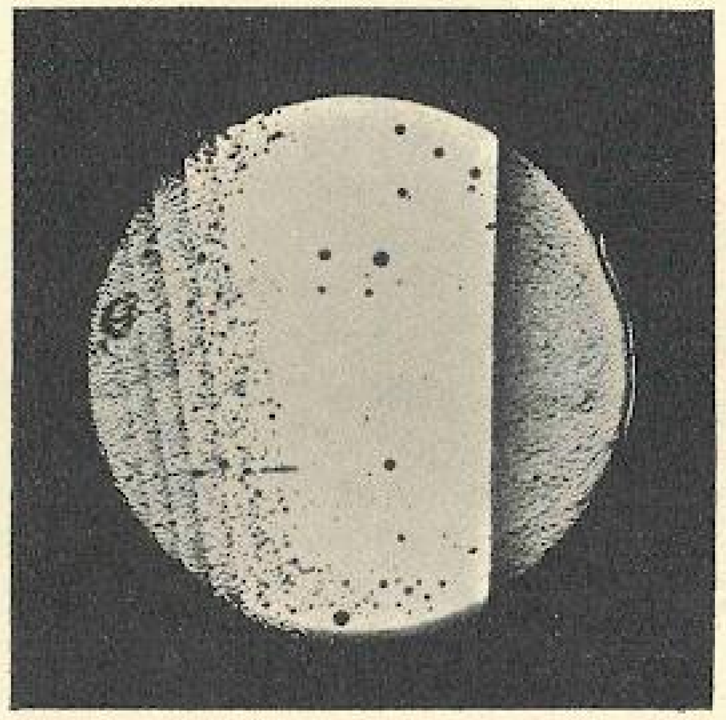

Fig. 12

illuminated for 10 minutes, has only one colony. Thus, after 10 minutes of illumination, we did not yet reach the absolute killing limit (by which I mean the point at which even the most resistant individuals are killed; this, however, can be seen from a second experiment, Fig. 13).

Here, 12 strips are illuminated in such a way that the one furthest to the left was illuminated for 6 minutes, the next for 7, and so on up to the 12th strip, which was illuminated for 17 minutes.

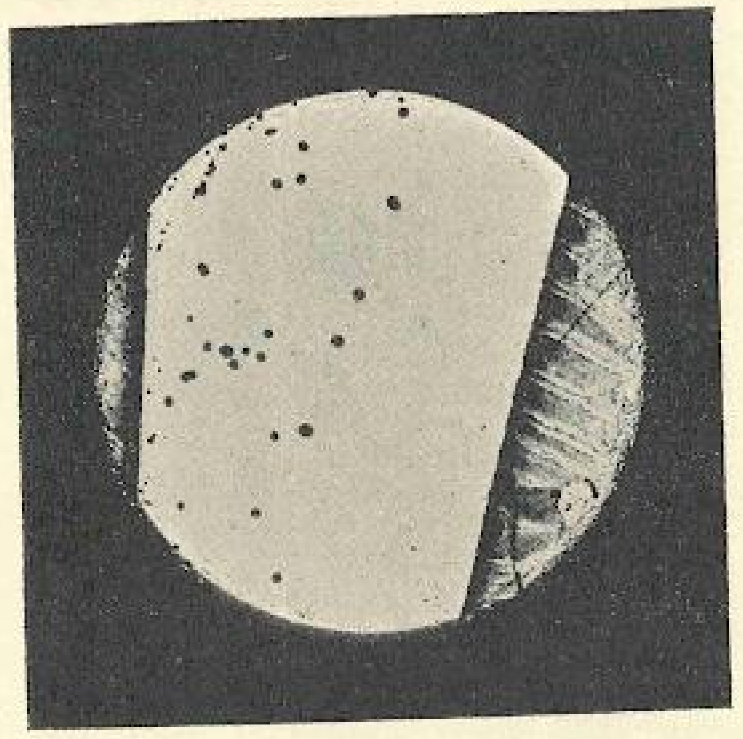

Fig. 13.

The number of colonies in the individual strips is approximately 10, 11, 2, 6, 4, 2, 3, 2, 0, 0, 0, 0. Thus, at the 14th minute, the absolute killing limit seems to have been reached. However, it is only very approximate and with reservations that one can set the absolute killing limit at 14 minutes after such an experiment; because where this limit lies is obviously based, among other things, on the number of bacteria sown per unit area.

apparently sharper limit can be seen after 4 minutes of An illumination (Fig. 12), where the number of colonies has become "countable," while the colonies in the previous stripes are so numerous that they merge. The position of this limit, which I will call "the relative killing limit" just for the sake of a name, also turns out to depend on how many bacterial individuals are sown on the agar surface per unit area. This can be demonstrated by an experiment with different dilutions of the same culture, as in the following series of experiments:

	Stock culture	Dilution 1:3	Dilution 1:9	Dilution 1:18	Dilution 1:36
Illumination 3 min.	Severe Decimation	Severe decimation	Strong decimation	approx. 50K.	Strong decimation
Beam 3/2	decimation – Strong Decimal	decimation – Strong decimation	decimation approx. 50K	22 K	approx. 50K.
,, 4 ,,	approx. 50 K	approx. 50 K	10	8	5
,, 5 ,,	30	12	1	0	4
,, 6 ,,	16	4	0	2	3
,, 8 ,,	2	4	2	3	0 ,,
,, 10 ,,	2	1	0 ,,	1	0 ,,

Thus, we find no sharp lethality limit for cultures of Staph. pyog. aur. The conditions here are quite similar to those I demonstrated earlier with regard to B. prodigiosus using the drop method, namely, an increasing decimation with increasing light exposure. With these, as well as with a whole series of bacteria examined later, it has consistently been shown, within certain limits, that the longer the exposure to light lasts, the smaller the percentage of bacteria that can resist it. But it seems that this "decimation curve"

has a different distribution and perhaps also a different form in the various bacterial species, as an indication of the different ways in which the unequal resistance of the individuals to light manifests itself in the different species. I shall not go into these conditions in more detail here, since they are currently the subject of special investigations.

At the present opportunity, I would only like to

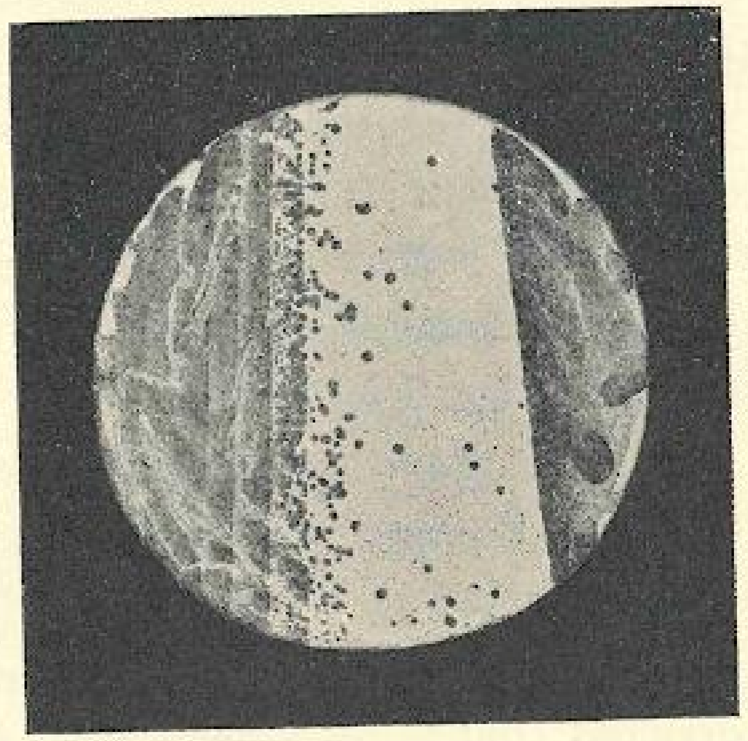

Fig. 14

To illuminate the usefulness of the method for "biological light measurement," that is, for determining the relative relationship between the richness of different light sources in bactericidal rays or the permeability of a light filter for such rays. It has now been shown that the position of the aforementioned "relative killing limit" can be used for many practical investigations of this kind—that is, the point in the culture where the bacterial colonies have become "countable" (approx. 50-100) instead of "uncountable." In 11 experiments with Staph. pyog. aur. on the described

Carried out "normally," the limit was 4.3/2, 4.3, 4.3, 4.3, 4.3, 4.2, 4.2 minutes, on average 3/4 minutes, with a margin of 3/4 minutes or 20% on either side.

This applies when the experiments are carried out at different times; the lack of exact agreement is due to the difficulty of obtaining uniform cultures. Much greater accuracy can be achieved, as I will show in more detail below, by comparative experiments carried out simultaneously or immediately one after the other on one and the same bacterial culture

Meanwhile, the discussed accuracy of 20% is already sufficient for many practical experiments, since it is often sufficient to obtain approximate values, among other things because the different light sources being compared often differ so enormously in luminous intensity. I will give a few examples of this. While a 30-ampere arc lamp at a distance of 60 cm, as mentioned, exhibits an average of 3.5 minutes of "relative killing," the same result is achieved at the same distance in approximately 4 seconds using an arc lamp with the same current intensity, but whose positive pole consists of a water-cooled iron rod. Direct sunlight needed over an hour on August 21, 1901, between 11 a.m. and 2 a.m. (in Copenhagen), to produce the same effect (see Fig. 6, where the position of the shadow generator is changed every quarter of an hour, so that the shortest illumination lasted 1/4 hour, the longest 3 hours).

example of the greater accuracy achieved when As an conducting comparative experiments with one and the same bacterial culture, I can mention that in repeated experiments (6 in total), it was consistently possible to demonstrate the difference in absorption which the light

undergoes when it passes, for example, once through 2 cm of distilled water and the other time through an equally thick layer of ordinary water. While the relative killing limit in this way, when the tube KMNK (Fig. 3) was screwed in so far that the light only had to pass through 1/2 cm of distilled water, was found to be 312 minutes, when the apparatus was filled with ordinary water, it was 5 minutes. If the thickness of the water layer was 3 cm,

	1/2 cm distilled water	1/2 cm wt. water	3 cm distilled water	3 cm wt. water
Exposure 3 min.	Thick decibels	Black decibels.	Black decibels.	Indication of
,, 3 1/2 ,,	approx. 50 K.	Decibels. Black	Decibels.	black decibels.
and 4 ,,	15 ,,	decibels. Decibels. Black	Decibels	Decibels.
,, 4.2,,	8 ,,	decibels. Decibels.	approx. 50	Black decibels.
,, 5 and	7 ,,	approx. 50 K.	K. 28 ,,	Decibels.
,, 5.2,,	0 ,,	30 ,,	10	approx. 50 K. ?
,, 6 and	O,,	20 ,,	3 ,,	

For distilled water, the lethal limit is 4.5 minutes, and for ordinary water, 5.5 minutes

From this, one can see how important the use of the clearest possible water is in the light filters of therapeutic apparatus. And it is therefore no wonder that the light absorption occurring in the commonly used nutrient media reaches a very significant level. To investigate this more closely, I filled the "photocteinometer" with broth instead of distilled water. I used a light-colored veal broth, which corresponds almost exactly in color to a 1/400 solution of bichromate of potassium; through a 2 cm thick

I illuminated a surface culture layer of this broth for 2-24 minutes without obtaining any apparent effect from the light; the experiment was repeated after one part broth was diluted with 24 parts distilled water, again with a completely negative result after 24 minutes of illumination. Only when the broth was diluted with 48 parts water and the thickness of the layer was reduced to 1 cm was the relative killing limit reached after an illumination time of 60 minutes. The layer of diluted broth used would correspond approximately to a 1/2 mm thick layer of undiluted broth. The light used in the experiment therefore needed 1 hour to exert the same bactericidal effect through this layer as it took 3-4.5 minutes to achieve when passing through 2 cm of distilled water. We have here direct proof of the necessity of eliminating the light absorption of the food substrates if one wants to investigate the effect of light on bacteria

Finally, I would like to thank Dr. Jansen for his valuable and tireless help in working out the details of the method.

The Treatment of Smallpox with the Exclusion of the Chemical Rays of Daylight. By Niels R. Finsen.

Two colleagues, District Physician Dr. Krebs in Vordingborg and City Physician Dr. Lunddahl in Aarhus, have, at my request, been kind enough to give me information about some cases of smallpox they have treated in red light, and with permission to publish them, for which I hereby express my sincere thanks. Dr. Krebs has one case, Dr. Lunddahl nine, some of them mild. Although these cases may be of little significance on their own, they are nevertheless important when added to the series of observations already available. Smallpox is, in any case, such a rare disease in this country that one must be grateful for every new observation on the effect of its treatment with the exclusion of the chemical rays of light

District physician Dr. Krebs writes the following:

"On September 4, 1900, I received a smallpox patient for treatment; the smallpox had broken out on the third. Only on the 6th was the patient interned in a Döcker felt tent with red cotton cloth in front of the windows.

The case was of a serious nature, and the exanthema would

would certainly have become confluent, not only on the face, but also on other parts of the body, if the patient had not been treated with red light. (He had 108 smallpox on his right hand alone, and "there are almost none here compared to the rest of his body," the patient said.)

Many nodules had turned into vesicles and partly into pustules when he was exposed to red light, especially on his face. An hour later, the tickling and stinging, the heat and tension in the skin associated with smallpox, began to subside, and by the next day the swelling had considerably diminished. Neither vesicles nor pustules developed further. There was no suppuration, nor was suppurative fever

Instead of the ugly brown and gray spots known from earlier times, a number of vivid pink nodules remained. These could be pressed away with the finger, but immediately filled with blood again as soon as the pressure was released, due to abundant vascularization. A number of pinpoint depressions remained on the face—no true smallpox scar.

For me, who had seen a large number of smallpox cases in the past, the mild course under red light treatment must have come as quite a surprise. The treatment certainly deserves to be consistently carried out in the future wherever the disease should manifest itself, since, in my opinion, it claims great and far-reaching significance.

Mr. City Doctor Lunddahl wrote to me on November 7, 1901: As agreed, I am sending you herewith a brief summary of my smallpox cases, especially with regard to their treatment in red light and its results.

No. 1. 5-year-old girl, vaccinated with good success

in the incubation period. Distributed varicella-like eruption. Only observed later in the course of the disease, since distributed infiltrations with tough, resistant scabs had formed. It took a long time for them to fall off, leaving behind scars that were nevertheless quite superficial. Not treated with red light

No. 2. 7-year-old boy, unvaccinated. Severe initial symptoms. Ill on April 15, 1901. Papular exanthema appeared on April 16-17. Admitted to the hospital on the 17th. Three double layers of red shirting were placed over the windows; this made the room very dark. Daylight was let in for a very short time during the rounds. The exanthema spread and became vesicular; at the same time, the temperature fell, but the general unfavorable condition remained. Suppuration began between the 22nd and 23rd; the temperature rose slightly in the morning (approx. 38°C); in the evening it had been 38 to 38.5°C. Confluence of the exanthema, continuous scab over large areas, with oozing pus. Decomposition with a disgusting stench. On the 24th, the temperature was 40°C. Death on April 26

This case had proven to be a very serious one from its very first onset. Although the patient was placed in the "red room" at the onset of the disease, even with very little light, the disease apparently ran its course unaffected. The only effect may perhaps be that there was no high fever at the beginning of the suppuration stage. It only set in when the pus was decomposing.

No. 3. 4-year-old girl, sister of the preceding patient, vaccinated immediately after the onset of the disease, no effect. Exanthema began weakly on the 18th, quite advanced on the 19th April. On the 19th, in the morning in the same room as her brother. Her general condition was very poor, but without a high temperature during the first few days. The exanthema spread everywhere, but did not become confluent; between the 23rd and 24th, the contents of the blisters began to turn yellow, and at the same time, a slight rise in temperature was noticed (38.4 in the morning), but the very next day her general condition suddenly improved. On the 25th and 26th, the pustules began to dry together into looser, less coherent crusts, which fell off placed quite quickly, leaving large, red, round spots, especially on the uncovered skin, which persisted for a long time. A number of fairly small and superficial scars also formed on her face. On May 4, the red light was removed. The exanthema itched only very slightly

No. 4. The children's mother was attacked so easily and with such an insignificant exanthema that it was not worth the effort to treat her with red light.

No. 5. Her newborn, 3-week-old child was taken at the same time as the mother (vaccinated shortly after. Initially, only a Widespread exanthema, very isolated outbreak, no success). isolated vesicles here and there, and apparent well-being. Only after about 8 days of the illness did the vesicles appear on a larger scale, confluent, and finally, almost the entire surface of the body was a suppurating area. The child died on the 28th. When the exanthema broke out more severely, red curtains were hung around the cradle, but during the first few days, when the eruption was very slight, nothing was done in this direction, which probably also proved to be a mistake

No. 6. A 51-year-old washerwoman. Infected by the aforementioned family. Sick since April 25. On

The morning of the 26th, widespread, papular, measles-like exanthema, temperature approx. 41, general condition poor. That same day, in the morning, first taken to a room with red window curtains, later to a room with red panes. That same evening, the temperature was 38.8, and became normal over the next few days. Very few blisters formed on the widespread initial exanthema, but the main mass of the exanthema disappeared without a trace. The general condition improved very quickly. The blisters quickly dried into small, tough scabs, leaving behind some minor infiltrations, and in the palm of the hand, isolated small bleeding spots. Overall, the exanthema of the epidermis decreased a completely abortive course. She remained in the red room which were used for about 13 days. Through the red panes, from then on, significantly more light came into the room; the patients could see, read, work, and generally felt comfortable in this light; there was never a particularly strong desire to escape it. Whether the large amount of light that came in—and it was during the brightest spring months—caused none of the patients, even the most — easily affected, to completely escape the scars, which, however, were shallow and will surely be almost invisible later, I cannot — say. (The scars only appeared on the exposed skin.) But even if that were the case, perhaps most patients would prefer such a brighter "red room" to a dark one, even at the risk of receiving a few small scars on their faces. I don't believe that the patients would have secretly let daylight in. They were too interested in the treatment and feared harm by violating it.

No. 7. A 7-year-old girl, vaccinated with good success during the incubation period. Ill since May 2nd, eruption on the 3rd, on the 4th a very widespread exanthema with yellow, pus-like contents. Her general condition was very little affected, temperature not above 38°C since admission on May 4th. Drying set in quickly with light, loose crusting and scales. Virtually no itching. She lay in the red light from the 4th to the 18th. Upon discharge in mid-June, large, red spots were seen all over her body. Small scars scattered across her face.

No. 8. 65-year-old woman, not vaccinated since childhood. Ill on May 4th. The following day, a widespread vesicular eruption, which increased in size over the following days, became confluent on the inner thighs, and was very dense overall Also severe mucous membrane eruption. The temperature, which was 39.6 on admission, fell quickly, was already 38 by the next evening, May 5th, and remained low for the next few days, but rose to 38 on the evening of the 8th and the morning of the 9th, as the contents of the vesicles became purulent in the severe and widespread eruption. Drying began early, on the face in the form of tough, dark scabs; on other parts of the body as scales and soft, yellowish crusts, mainly just peeling. The mucous membrane eruption disappeared very suddenly. The general condition was good after the first few days. Lying in red light for a good 14 days. Slight scarring on the face, as in the previous cases.

No. 9. A child died of purpura variolosa one hour after admission

Nos. 10 and 11. Younger women, unvaccinated since childhood, with mild cases of variola discreta; a transitional form to varioloids. Each of them was

observed at home for about 4 days. Treatment with red light from admission onwards for about 10-12 days; the blisters dried into small scabs or disappeared completely, leaving small, red spots. Some of them on the face left scars similar to those described earlier.

No. 12. Younger woman (in her thirties), ill since May 15, papular eruption on the 17, vesicular eruption began on the 18. High fever and severe initial symptoms; the exanthema spread widely. Severe mucous membrane eruption. Admitted on the the first — morning of May 18 General condition was poor for few days (she was also 5 months pregnant), with significant improvement on May 21. At this time, some of the blisters began to develop a yellow content (no particular increase in temperature corresponding to this stage). The course of the eruption was generally as follows: On the forehead, the blisters dried into small crusts; on the rest of the face, the contents were reabsorbed, and papular infiltrations remained. On the body, and especially on the lower extremities, the blisters filled with yellow content, which was also reabsorbed in the meantime. In some places, small, yellowish, loose crusts formed, and in most places only scales. The mucous membrane eruption suddenly disappeared.

— She was in a red room for 14 days. Upon discharge on June 28, her face was densely covered with red spots, and numerous scars formed, especially on her forehead; denser but not deeper, and no larger than in the previous patients

Nos. 13, 14, 15. Two younger women and a small child, all from the country, arrived so late and with such mild cases that red light treatment was dispensed with

With regard to the effect of the red light treatment, one could perhaps say that it had no particular significance for No. 2. The fact that No. 3 progressed well can perhaps be attributed to the treatment. Whether No. 5 would have been saved if the treatment had been carried out from the beginning is doubtful, given her young age. No. 6, in whom the illness began quite violently and took an abortive course, and No. 8, in whom it progressed quite well despite a violent onset and an extraordinarily widespread exanthema, as well as No. 12, who also had a very widespread eruption and whose condition proved quite serious in the first few days, can also be counted among the good results. Whether the red light treatment had any significant significance for the cases Nos. 5, 10, and 11, who were mild from the start, cannot be decided

When I received these case reports, it seemed to me that the results, both in terms of the overall course and in terms of scarring, were less good than they usually are with red light treatment. Since Journal No. 2 mentioned that daylight had been admitted for a short time during the rounds, I suspected that the less favorable results might be due to such a brief admission of daylight. I wrote to City Physician Lunddahl about this and asked for information on this question, as it was of particular interest because nothing definite is known about how much light or how long exposure to daylight is sufficient to cause harm. I also asked about the condition of the patients' smallpox scars after half a year; experience shows that even if patients have small scars upon discharge

after red light treatment, these scars disappear after a short time because they are very superficial

City Doctor Lunddahl was kind enough to examine the patients again immediately, and it turned out that only Patient No. 3 could be described as having pockmarks to a certain degree.

Regarding daylight, I received the following information: "Daylight was let in for all patients during the rounds. For the first two, the curtains were pushed aside slightly; for the others, the windows were left ajar. There was never any mention of prolonged exposure to daylight; a lot can be seen in half a minute, and I don't believe it lasted longer each time. On the other hand, it could have happened a few or more times during the day. Due to the circumstances, there couldn't be a specific round time here, so the patients could be demonstrated at specific times; but the local colleagues could go in whenever they wanted to see the patients. This meant that the patients were possibly exposed to daylight several times, but probably for shorter periods."

This information is of great interest and gives these case reports greater significance, as we seem to have clear confirmation that even very short exposure to daylight has a harmful effect and should be avoided. On the other hand, the use of a stearin light or an ordinary kerosene lamp will not cause any disadvantage to the patient. It may even be possible to leave a stearin light or a kerosene lamp burning all day without harm to the patient, since there are few chemical rays in such light. But the opportunity to experiment with this

Yes, rarely. A series of experiments to investigate and determine which artificial light, and how strong artificial light, smallpox patients can tolerate without experiencing suppuration would be of great importance, partly because some people apparently have an aversion to red light, and partly because the treatment could be carried out anywhere, even where there were no red panes or red window curtains

I would also like to point out here that now that the method has fully passed its test, it is the doctor's first duty—as soon as he has diagnosed smallpox—to ensure that, by one means or another, the windows of the sickroom are tightly closed and that lights are lit. If the treatment can be arranged so easily, it is actually irresponsible to leave the patients exposed to daylight until they can be exposed to red light in the hospital; the better the chance for the patients of escaping suppuration and its consequences.

The Treatment of Rose with Exclusion of the Chemical Rays of Daylight.

By Niels R. Finsen

When I published my treatment of smallpox with the exclusion of chemical rays of light eight years ago, I emphasized that this was "not a special treatment for smallpox, but a new therapeutic principle that could probably become important in other exanthematous diseases and skin diseases." I pointed out how interesting it would be to gain clarity about whether or not chemical rays had any influence on these diseases, and emphasized how easy and at the same time harmless it would be to conduct such experiments, for example, in measles, scarlet fever, and rose. At that time, I made some effort to initiate such experiments, but since I encountered some difficulties and was simultaneously ill and unable to work, nothing came of it. I therefore limited myself partly to some statistical studies to see whether there was a difference in the course of the aforementioned diseases in summer and winter, and partly to suggestions on how to conduct experiments and control trials

Some time later, Corps Physician Dr. Kier, who was then senior physician at the Garrison Hospital, kindly offered me the opportunity to conduct experiments with this treatment in his department. Since several cases of rose disease were discovered at the time, we began with this disease. At my request, Dr. Kier himself undertook the treatment; I only assisted with the installation. In total, only seven cases of rose disease were treated, since Corps Physician Dr. Kier's service was ending at that very moment, and the new senior physician did not attach any importance to continuing the experiments. Since it seemed to me that there were too few and insufficiently developed cases to draw any definite conclusions from them, neither positive nor negative, they were not published

Very recently, a report appeared from Dr. Krukenberg, senior physician at the municipal hospital in Liegnitz, on the treatment of several cases of rose in red light. This has given our seven cases some value as a supplement to those of Dr. Krukenberg. I have now obtained permission from Dr. Kier and the current head of the garrison hospital, Staff Surgeon Dr. Bjerring, to publish them and hereby express my sincere thanks to both of them.

To avoid any misunderstanding, I would like to add that it is not my intention to attempt to deprive Dr. Krukenberg of priority through this publication; but since these seven case reports do not show results as favorable as those achieved by Dr. Krukenberg, I feel there is a special reason, indeed a certain duty, to publish them now

I will first present a review of Dr. Krukenberg's treatise, which is due to Dr. Jansen, and then Dr. Kiers's case reports.

Hermann Krukenberg: Treatment of Erysipelas in the Red Room.

International Journal of Physical Therapy. February 1, 1902.

The author, who is head of the commune hospital in Liegnitz, treated a number of cases of erysipelas in the Red Room during the year 1900, spurred on by an article by Dr. Bie in the "Therapeut. Monatsh.", which gives a comprehensive description of Finsen's entire phototherapy, both "negative" and "positive."

Right at the beginning of the article, Dr. K. expresses his opinion that this treatment has a very beneficial effect on the disease and adds the remark that Dr. Roemer, at the same hospital, has also used the method successfully. But, on the other hand, he himself emphasizes how difficult it is to say anything definite after a single, relatively short series of observations. Especially when it comes to a disease like erysipelas, which can be very capricious in its course and can sometimes be spontaneously cured in a few days, which gives rise to the superstition that the rose can be cured by "incantation."

Dr. K. had the opportunity to apply the treatment to 13 people. If one counts the recurrences as independent cases, one gets a total of 18 cases. There were 15 cases of facial erysipelas of the usual type, 3 of which were located partly on the body and partly on the lower extremities. All patients were placed in a red room shortly after the onset of the disease, and with the exception of the first three, who received some alcohol compresses, no other treatment, either internal or external, was applied. Dr. K. does not appear to have treated other erysipelas patients in the usual way at the same time. It would have been a somewhat safer starting point for evaluating the new treatment than to point out, as Dr. K. did, that the average duration of facial erysipelas can be standardized to at least 1 week; for the erysipelas in Liegnitz could have been particularly benign at that time, where the experiments were conducted. The observations that Dr. K. made during the treatment of these 18 cases in the red room are the following:

The fever usually lasted only two days. It often stopped the day after, or at the latest two days after the patient was taken to a red room. Only in two cases was it different, but in one it was due to pneumonia, in the second, it seemed, to poorly executed exclusion of the harmful rays.

This was otherwise done with a care that cannot be sufficiently praised. A sickroom in the epidemic department had been completely transformed into an excellent photographic darkroom: the window panes were made of ruby glass, the walls and floor were painted red, and lamps like those used by photographers had red glass and coverings. Even the surrounding rooms: corridor, anteroom, closet, and bathroom had red

Window. In this truly "red room," 14 of the cases were treated. Of the remaining 4, 3 were in absolute darkness and also gave good results, while 1, and this was the one I referred to above, was in quite unfavorable conditions, namely in an ordinary room with 4 windows that were covered, but which, according to what Dr. K. later learned, had been open during morning cleaning. In this particular case, the fever persisted for 6 days with a temperature between 39 and 400 degrees Celsius, the illness spread, and the general condition was poor

When discussing the instructions, Dr. K. touches on how often one encounters a complete misunderstanding of the whole matter. There are people who believe that it is a treatment with red light, that one only needs to shine a few red rays of light on the patient's affected areas, similar to how one can give a steam shower. Dr. K. observed the following in a place where he had recommended a red room: The patient lay in his bed in a sea of sunbeams, while at his side stood a burning lamp with a red glass. And this, moreover, was with a doctor.

With regard to the exanthema, Dr. K. comments that the initially sharp borders disappeared within 12 hours, and the progression ceased. However, slight redness and swelling often persisted for several days. Vesicle formation and squamous desquamation of the epidermis did not occur, as was often the case in earlier times. The process often ended with fine desquamation

There were a total of 5 relapses, but none of the relapses occurred while the patient was in the red room. They only occurred after the patient had returned to normal daylight; twice even on the same evening on which the patient was discharged.

The only complications noted were pneumonia in one patient, severe headaches, and fatigue in the patient who was so inadequately treated.

It would have been desirable for the author to have reported how the patients were in the red room. The case is still so new that any information on this matter is valuable

At the end of his article, the author attempts to find a theoretical explanation for the treatment. Would it be possible that Streptococcus erysipelatis thrives better in the light than in the dark? No, this contradicts the numerous experiences regarding the bactericidal effect of light and some experiments conducted by the author himself. (Here at the Light Institute, we also conducted some experiments with streptococci. They showed no particular resistance to light.) Rather, as Finsen said long ago, it must be assumed that it is the skin-irritating ability of light that causes the rash. And just as Finsen expressed his opinion regarding smallpox, Dr. K. also believes that some of the remedies used to date for roses are probably...

only work by excluding light (such as ichthyol, iodine tincture, etc.). In a very interesting way, the author also draws attention to some experiences regarding the pathology of Negroes. According to Daeubler and Plehn, erysipelas and phlegmon are very rare among Negroes, and the fact that this is something peculiar to Negroes and not attributable to the peculiar climatic conditions seems to be evident from a report from the hospital in Dar-es-Salaam (in German East Africa), where both Europeans and Negroes are found. Erysipelas is never observed in the latter, but quite often in the former. Possibly, it is the pigment of Negroes that protects them against the aforementioned disease.

I will reproduce here in extenso the brief case reports that accompany this treatise

1. F. W., 24-year-old nurse. Last year, she suffered from erysipelas twice, lasting 6 and 5 days respectively.

April 1, 1900. Eczema on the nose, half of the left cheek, and part of the forehead. Evening temperature 39.6.

Red room.

April 2, 1900, morning: 38.5. No spreading. Fever-free in the evening. Redness disappears.

A. S., 15 years old. Had pain for 4 days and her face was somewhat swollen. Admitted.

April 21. Erysipelas almost over the entire face. 38.3.

Epithema, alcohol. Red room.

April 22.
37.2*) 38.3. Erysipelas has reached the hairy part.

April 23. 36.8. Well-being
36.6

3. B. J., 19 years old. Has had redness, pain, and swelling on the right leg for 3 days without any identifiable cause. Admitted April 31st.

Characteristic erysipelas on the right leg with irregular barely extends to the foot, centrally to the knee. 38.0.
edges;

1. May 3716. Erysipelas has spread to the foot. 39.3

Red room.

2. May 38.2. No spread. 8315

3. May 3712. 4. May Temp. below 37. The swelling is going down.
3715

4. K. P.; 25 years old. Admitted April 20th due to sycosis.

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*) Temp. above the line, morning, below the line, evening temperature for the day in question

May 2nd, 400. Erysipelas develops on the left cheek.

Red Room.

May 3rd-6th. Morning temperature approx. 390. Evening temperature approx. 40. Erysipelas extends over the entire face. General condition, poor.

May 7th-8th. Fever falls somewhat.

May 9th. Fever rises. Right-sided pneumonia, bloody sputum, etc. The swelling in the face disappears.

May 12th. Afever-free. Well except for a few stitches in the side.

May 5th. A.M., 54 years old. Mentally ill. Unwell for 3 days: fever, swollen nose. Admitted

May 18th, 390. Erysipelas on the nose and left cheek up to the ear.

Red Room

May 19th, 37.14. May 20th-21st, below 37.0. Swelling decreasing.
38.6

May 22nd, morning: sunlight. Evening 39.0. Recurrence.

Red Room.

23rd, 37.1. May
36.7.

May 25th, daylight.

6th, P. S., 55 years old. Treated for several months for glandular tuberculosis on the right side of the neck and in the axillae. June 12th, evening temp. 38.5. Unwell.

June 13th. Erysipelas is seen, originating from a fistula and extending over the entire right side of the neck and part of the cheek. Evening temp. 39.16.

Red Room.

June 14th, 38.8, Erysipelas spreading over the right side of the face
39.0

June 15th. Fever stops. Still feeling unwell. The swelling only stops completely on June 17th. Daylight.

7th O. W., 15 years old. Said to have had erysipelas a year ago with a fever lasting 8 days. Had erysipelas over almost the entire left side of his face for 2 days, as it was being soaked. October

15th. 38.6

Red Room.

38.2
October 6th. Erysipelas up to the ear. October 17th.
37 38.0 37.6

The following days below 370. The swelling disappears. October 20th. Sunlight. October 26th, towards evening, fever: 39.1. Recurrence on the left cheek. Redness the size of a palm.

Red Room,

October 27th-28th. Intermittent fever,

October 29th. Fever stops. But a slight swelling persists in the entire face for a few days.

8. M. T., 25 years. Has had redness and pain radiating from the nose and swelling in the face for 8 days. Admitted:

November 5th. Erys. of the entire right side of the face.

Red room.

November 6th, 370. The swelling is going down. November 7th. Fever stopped.
377

9. P. W., 31 years. Was in the eye department because of corneal ulcer. At night between November 29th and 30th, facial pain.

December 1st. Admitted because of rash extending over almost the entire face. 39.90

Red Room.

December 2nd. Evening temp. 39.30. Erysipelas reaches the ear.

December 3rd. 39. Less headache. Redness fades. December 4th. Afebrile.
37.9
Less swelling. December 8th. Sunlight.

October 10th, 15 years (No. 7). November 26th. New erysipelas. Admitted November 27th. Erysipelas already extends over nose, cheeks, lips, eyes, and part of the forehead. 390.

Red Room.

November 28th. 37.12. No progress. November 29th. Afebrile. The swelling
38.2
everywhere considerably reduced. December 1st. Sunlight. Until the 6th/12th, a slight swelling of the left cheek persisted

2nd Th. K., 52 years old. Nurse in a deaf-mute asylum. Got erysipelas on the 6th/10th. Characteristic redness and swelling on the nose and cheek.

39.

40
7th/10th. Red room with exclusion of sunlight, as best as possible in a room with four windows.

Slow progression. Temp. unchanged high..

8th/10th-10th/10th. Same condition. Poor general health. Erys. spreads over the hairy head.

11th/10th. Temp. falls. 12th/10th. Free of fever.

12th A. M., 37 years old. In the asylum for the idiots. 30th/10th. Erysipelatous redness and swelling on the right side of the face, originating from a nasal excoriation. 37.50

Dark room; the staff needs a red lamp when they enter.

October 31. Below 370. The redness disappears.

November 2nd. Consistently no fever. Redness gone. The right side is beginning to peel.

January 13th. J.W., 19 years old. In the idiot asylum. Treated for ozaena in October.

November 14th. Erys. of the nose, cheeks, and the left half of the upper lip. 37.80. Dark room (as No. 12).

Temp. stays below 370. Redness no longer spreads and disappears during the next three days.

December 3rd. Fresh erys. on the left side of the face and inside above the left eyelid.

Dark room.

December 4th. Afebrile, but erys. has spread over a large part of the body. spread.

December 6th. Consistently no fever. Redness disappeared.

December 8th. Sunlight

14th H. M., 51 years old. Operated on April 19, 1900, for recurrence of penile carcinoma. There is still a fistula above the pubis, which secretes slightly.

February 2, 1901. Redness and swelling of the right cheek and the lower eyelid suggest erysipelas. February 3. No fever, but the swelling has spread over the left cheek.

Red Room.

Here, complete freedom from fever. The swelling decreases immediately and has completely disappeared on February 6. The patient is sent back to his department on February 8. The same evening: 38.50. A plate-sized erysipelas originating from a fistula and already on the left thigh.

Red Room.

Immediate cessation of fever, the erysipelas disappears

Excerpt from the journals on the cases of rose treated in red light at the Garrison Hospital by Corps Doctor Dr. Kier:

No. 1. Steenberg's wife. In the hospital from November 18th to November 28th, 1893, for erysipelas faciei and acute nephritis. The illness began 2 days before admission with chills, severe headache, and swelling of the nose. On admission on November 18th, temp. 40.2. Erysipelas all over

left cheek, eyelid, nose, and part of the right cheek. Several blisters.

Epith. boric.
Acetanilidi
Centigr. 25

November 19th (40.3%). Erysipelas now spread on the right side as well as on the
40.2
left. No appetite. Poor sleep due to headache.

Wine, milk, ice compresses.
Syrup morphine hydrochloric. 1 teaspoon.

November 20th (394). Erysipelas has spread further over the
40.4
hairy parts and over the ear. Pulse 108, weak.

Red room

November 21st (40.4). Good sleep without narcotics. Feels
40
somewhat better. Swelling and redness of the cheeks have subsided somewhat, but the affection has spread over the forehead and beyond the hairline. Pulse 120, quite strong. Apnea extremely slight, drinks only wine and milk.

November 22nd, 392. Pulse 93, strong, was less well yesterday,
37.6
but now good towards morning. The erythema has not spread since yesterday, the swelling and redness in the face have subsided considerably, so that the face is almost completely normal today.

September Glacies.

She is beginning to feel like eating.

November 37.5 37. Patient is generally well. She slept well
23rd,
during the night. No headache. The erythema has not spread. Redness and infiltration, even in the hairy parts, are decreasing. Remnants of blisters all over the face. Appearance good.

November 24th, 37. Constantly subjective. Well. Still some
36.8
sensitivity to pressure in the left temporal region.

September

Red Room.

In the following days, albuminuria was diagnosed, which is why the patient was transferred to another department. There was no recurrence

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*) Temp. above the line, temp. of the previous evening, —— below the line, temp. of the current morning.

No. 2. ANDERSEN*), 23 years old. Admitted on November 28th for erysipelas in association with vulnus contus capitis. Temp. 40.5. Marked erysipelatous redness and swelling of the left cheek and over the left side of the forehead, as well as over the hairy part of the head on the left side.

Red room.

November 29th. 40.4. Slept little at night. Quite severely 40.7. affected. P. 108, regular and strong. The erysipelas has spread over the entire forehead and lower to the right cheek. Urine normal.

Rp. 1 siphon

November 30th 405. Subjective well-being. Slept well during the night without narcotics. Drinks his milk and wants more. No headache, does not feel particularly weak. The erythema has spread over the entire face. Edema of the eyelids. Abundant vesicle formation on the nose. Pulse strong.

Rp. 4 milk. Sep. 1 siphon.

December 1st 395. The erythema has spread behind the right ear and further into the neck region. Quite significant redness and swelling all over the face, especially on the right side. Reports subjective well-being. Pulse 60. Urine normal. A large bulla on the nose has completely dried up.

December 2nd 39.0 Reports subjective well-being. The erythema has spread to the left parotid region and to the left ear. On the right side, the process has disappeared. Urine normal

December 3rd, 408. Feels quite well, slept well after 38.2

Chloral morphine syrup.
1 teaspoon.

The rash is severe on the left side of the head, especially on the left ear. Wishes to eat more.

December 4th, 38.5 36.5 Well-being. Good sleep during the night after

Morphine syrup, 1 teaspoon.

The rash has disappeared everywhere except in the left ear, where some tenderness and swelling still remains. Urine normal.

December 5th, 370. 36.5 Still insignificant tenderness and swelling in the left ear. Appetite and sleep good. Urine normal.

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*) Unless otherwise stated, the patient is a man (commoner).

6/12. 36.9. Still a little swelling on the left ear. 36.5

7/12. $\frac{36.7}{36.5}$. Swelling and redness now completely disappeared. Condition good. App. good. Desquamation on the cheeks and ears.

Sep. Milk.

Desquamation all over the face and head.

Sep. Red room. 8/12.

The following days, natural conditions. Discharged 12/12.

No. 3. KUNDSEN, 20 years old. Admitted on 19/12. The illness began about 2 days before. 37.5. The nose is somewhat red, swollen, and sensitive; the same applies to the adjacent parts of the cheeks. Red room.

20/12. 3711 37 Well-being. The erythema has not spread. Urine normal.

December 21st 37.1. 36.6 Complete well-being. Swelling and redness of the nose and the adjacent parts of the cheeks have completely disappeared. Desquamation of these parts.

December 22nd 37. 36.6 Well-being. Nose normal.

extra lectum.

December 23rd Well-being. Nose normal.

Discharged.

No. 4. Kirkegaards, woman, 32 years old. Admission: December 14th. Two days ago, chills and malaise, as well as redness of the nose. Temp. 410. Nose and cheeks show significant erysipelatous redness and swelling. The affection extends over the ears on both sides and up to the eyes. There is no edema of the palpebrae. Distinct, sharp borders. Blistering on the right side of the nose and right cheek.

Rp. Ice.
Red Room.

December 15th $\frac{39}{40}$. Patient slept a little during the night after taking a narcotic; Vomited once. Redness and swelling spread up to the forehead. Significant edema of all four palpebrae. Copious blistering on the nose and chin. Pulse quite strong, regular. The urine contained traces of albumen

December 16, 1940. 39.9 Somewhat interrupted sleep during the night. The condition essentially unchanged. The rash has spread somewhat to the hairy parts of the head; but swelling and redness of the face, as well as the edema of the eyelids, have decreased considerably. Some albumin in the urine.

December 17, 39 Has somewhat improved after taking morphine juice during the night. Sleep. 1940 39.5.

The rash spreads over the neck and ears. On the face, however, it has disappeared, and all the blisters there have dried up. Feeling generally better. Desire to eat

December 18th. 38.4 37 Slept well during the night without narcotics. Feeling better today. The rash has not spread. Swelling and redness are still present on both ears and the adjacent parts of the neck. No particular tenderness on the hairy part of the head. The face is heavily scaling. Appetite is good. Traces of albumin are found in the urine.

September Ice, milk, and wine.

December 19th 36.9. 37 Slept well during the night. Overall, feeling well. The rash has disappeared almost everywhere, only some tenderness in the neck.

December 20th 37 36.8 The rash has now disappeared everywhere.

September

Red room.

The albuminuria persisted until discharge on December 23rd

No. 5. STEENBERG. Admitted on December 18th. Illness began 1.5 days previously with severe chills. The patient is very weak, sleepy, and dull. Temp. 40. Significant erysipelatous redness of the nose and adjacent parts of the cheeks.

Red room.

December 19th 40.3. Redness and swelling have spread greatly 40.3 to the cheeks and forehead. There is edema of all eyelids. Blistering on the cheeks. Slept during the night without the use of hypnotics and is soporous. Pulse regular but weak.

December 20th 39.8. 40. Sleep has been poor during the night. The

The rash has spread across the forehead and to the ears; however, it has disappeared somewhat on the cheeks. General condition, overall poor.

21/12 40.9. 40.1 Pulse 108, regular, strong. He reports feeling better. Slept a little during the night after morphine. The rash has spread up to the hairy part of the head in a line corresponding to the coronal suture. Quite severe swelling on the forehead and tenderness therein. The affection has disappeared on the cheeks and nose. The bumps have dried up. Desquamation on the face. Moderate thirst. No appetite. Urine normal.

22/12 40.4. Pulse 96, regular. Slept well after morphine during the night (39.7). Feels overall better. The rash has spread up to the vertex and temple region, but has disappeared on the face

December 23rd, 40.1. 39 Condition seems somewhat better. Today swelling and tenderness of the entire neck region and the right ear. The erythema multiforme in the face has disappeared.

December 24th, 40.4. Was dazed yesterday during the day. Wanted to be discharged at 38.5 and get out of bed. Slept well during the night without morphine. Feels quite well towards morning. The erythema multiforme is about unchanged. Begins to feel like eating.

December 25th, 40. Feeling better. Was clear yesterday. Slept well during the night. 3735. The erythema multiforme has hardly spread, but there is some swelling and tenderness of the left side of the neck and the right ear. The process in the face has considerably disappeared; there is severe desquamation there

December 26th 40.3 40 The erythema appeared again today on the left side of the face. Edema of the palpebrae of the left eye. Sopor. Pulse 86, regular, quite strong.

December 27th 39.8 Slept well during the night. The erythema has not spread, but is starting again on the left side of the nose.

December 28th 391. Feeling quite well. The erythema is now decreasing again

December . 39.6 37.6 Feeling well. Redness, swelling, and tenderness
29th
of the left ear are still present. Severe flaking of the face.

December 30, 372. Well-being. Good sleep during the night.
36.8
Only erythema in the left ear, normal urine.

12/31 40.6. Felt unwell last night. Chills. Pain behind the left
37.8
ear. Today the condition is better and the pain has subsided. Nothing objectively abnormal. The erysipelatous process is resolved. Severe desquamation.

September
Red room.

The following days: Discharged in good health 4/1.

No. 6. Hansen, 22 years old. Admitted on December 24th. Illness began approximately two days ago. 37.6. There is erysipelatous redness of the nose and the adjacent parts of the cheeks. No blisters. No clear border to the exanthem.

Red room.

25/12 38.5 15. The rosacea has spread to the left ear.

There are now distinct, wall-like borders above the temporal region. 39

40
26/12. Subjective well-being is good. Slept well. Appetite is good.
39.2
The erythema has spread over the right side of the face and beyond the hairline. Urine is normal.

27./12. 3915 The rose has spread slightly over the left ear
37:6
Well-being

28./12. 37 The rose is very pronounced on the left ear today.
38,3.

29/12. 37.7. Still redness and swelling of the left ear.
Severe
sensitivity and swelling of the glands behind the left ear. Subjective well-being,

Rp.
Epithem, tepid.

30./12. 375. The mentioned sensitivity of the glands has
37
disappeared, still redness and swelling of the left ear.

31./12. 36.7/36.6. Complete well-being. Only some redness of the left earlobe.

September
Red room.

The following day continued to feel well. Discharged 6/1.

No. 7. Kirkegaard's wife, 32 years old (see No. 4). Admitted on December 26th. Became ill again immediately after discharge from her previous hospital stay. 39.9. There is some redness and swelling of the nose and adjacent cheeks. Some edema of the lower eyelids of both eyes. A few isolated bumps on the nose.

Red room.

27/12 39.7 37.9

December 28, 376. Slept quite well during the night. Overall,
the
condition improved. The erythema has not spread. Urine normal.

December 29, 376. Well. No spread of the rose. Face almost
36.9
natural.

30/12 37.6 Well-being. The erythema has subsided somewhat on
the
face, 37 still some tenderness and swelling in front of and behind the ears. Urine normal.

31/12 37 Well-being 37

Released 9/1

As can be seen, it is not possible to draw any substantiated conclusions from these seven case reports. In cases 1, 2, and 3, where one could assume a favorable effect of the treatment, it is possible that the outcome would have been just as favorable without treatment. On the other hand, the cases where the fever persisted and the disease spread despite treatment are also not conclusive evidence against the value of the therapy; for without this treatment, the outcome would have been

Perhaps it would have been even worse. The capricious nature of this disease makes it impossible to draw a conclusion from it. Since Dr. Krukenberg's good results are available, there is every reason to continue with the experiments, which would best be carried out systematically in a larger hospital, along with control trials. This treatment has the advantage over so many others in that it can be used without hesitation because of its harmlessness.

Literature review.

PAUL DARBOIS: TREATMENT OF VULGUE LUPUS FOLLOWING INDICATIONS. Paris 1900

The author discusses the technique and results of a number of different treatments for lupus vulgaris, a total of approximately 30. Of these, in his opinion, the following are capable of curing the disease: scarification, ignition puncture, galvanocaustic scarification (ignée scarification), surgical methods (excision, scraping), and Finsen's caustic method. Of newer treatment methods, the author considers the following incapable of curing the disease: Koch's tuberculin TR, streptococtoxin, various serums, Holländer's hot-air method, calomel injection, d'Arson-val's currents (high frequency and high intensity currents), electrolysis, and X-rays

It is interesting that d'Arsonval's currents, which achieved good results against lupus erythematosus, had no ameliorating effect on lupus vulgaris

An ideal treatment, says the author, must be easy to apply and painless, as well as produce rapid, definitive healing and beautiful scars. Regarding these individual points, he notes that 1) none of the other methods produce scars as beautiful as those produced by scarification and the Finsens method; 2) definitive healing is possible with all of the methods mentioned, provided that the patients can be kept under observation for at least two years in order to treat any recurrences and remaining lupus foci. The author therefore does not consider it an objection to Finsens' method that patients must undergo one or more short follow-up treatments in the first few years after completion of the main treatment; 3) the quickest treatment is undoubtedly excision, provided that it is achieved prima intentio. The author therefore recommends treatment in cases where the condition is operable and is located in a location where the appearance of the scars is of secondary importance. In terms of speed, Finsen's method comes second. With all other methods, including scarification, it takes longer to heal than with Finsen's method; 4) the author rightly considers the painlessness of the treatment to be one of the most significant points. None of the other methods can be equated in this respect with Finsen's, which causes no or almost no pain.

From the above, it can be seen that the author considers Finsen's method to be the most perfect. In his "Conclusions," he expressed this view as follows: "Finsen's method is indicated in the majority of cases. However, lupus of the mucous membrane cannot be treated using this method. Furthermore, it cannot be used on rural people and poor people who do not come to the hospital."

"With these reservations, it can be said that, due to the relative speed of its action and the excellent scars it leaves behind, Finsen's method is the best of all the treatments used in lupus therapy."

This recognition of the superiority of Finsen's method takes on increased significance by the fact that the author expressly notes in his introduction that it was Dr. Brocq who first gave me the idea for this work, and it is he who partly inspired the conclusions."

Valdemar Bie.

LEREDDE: PHOTOTHERAPY AND ITS APPLICATIONS FOR THE THERAPY OF CUTANEOUS AFFECTIONS. Bulletin Général de thérapeutique. 70th année, vol. 141, p. 129

LEREDDE: LA CURE PHOTOTHÉRAPIQUE DU LUPUS ÉRYTHÉMATEUX. Bulletin de la société de thérapique. 36th year, 4th series, volume VI, no. 1, p. 21. The author gives a detailed report on Finsen's "La Photo-thérapie" and also publishes his own experiences with treatment with concentrated light according to Finsen's method

Regarding the results of the treatment of lupus vulgaris, the author is of the same opinion as Darbois: Finsen's method is the least painful and results in the highest percentage of cured cases, the most reliable definitive cure, and the most beautiful scars. He, too, makes only one objection: the costly nature of the treatment will prevent poor patients who cannot get into a hospital from using it. However, he assumes that the head of public welfare will realize that it is cheaper to ensure the cure of such patients than to place them in poorhouse sooner or later.

Leredde treated a patient with acne rosacea nasi. Significant improvement was achieved, but so slowly that if this were to be the rule should, Leredde can only recommend light therapy in the few cases of this disease that are refractory to the usual treatments

On the other hand, he was very satisfied with the results of light therapy in a severe case of rhinophyma; the lower part of the nose was twice as large as normal and had transformed into a blood-filled sponge. After 30 séances lasting 1/2 to 1 hour, he achieved a significant reduction in the size of the nose, and the color became bright red.

Furthermore, the author treated two cases of sycosis several years old, which had defied all treatment. In one case, a very marked improvement was achieved after 12 séances

In "La Société de thérapeutique," Léredde published his experiences on the treatment of lupus erythematosus with concentrated light, according to Finsen's method. He treated 11 cases, almost all of which had previously been treated with great perseverance, but without result, using virtually all known methods. The author is particularly interested in the fact that one of the patients, who had previously been treated without result, including in 70 séances with D'Arsonval's currents—in his and Brocq's opinion one of the best treatments for lupus erythematosus—improved significantly after 22 séances of light treatment —

In 2 of the 11 patients treated, only slight flattening, reduction of congestion, and atrophy of the epidermis in the treated areas were achieved. The author notes that the treatment was too short (10-12 séances) to allow any definitive judgment. In 3 severe cases, the author achieved partial healing and, as far as the rest of the condition was concerned, significant improvement.

Finally, in 3 cases, complete healing was achieved after 35 and 45 séances, respectively, and 3 other patients, whose treatment is not yet complete, improved so much after 40, 22, and 30 séances that Léredde can predict a complete cure. All in all, Léredde considers that Finsen's method is "the best method for treating severe forms of lupus erythematosus."

VALDEMAR BIE

MALCOLM MORRIS AND S. ERNEST DORE: REMARKS ON FINSENS LIGHT TREATMENT OF LUPUS AND RODENT ULCER. British Medical Journal No. 2093, 9 February 1901, p. 326.

In this article, among other things, there are some valuable remarks regarding the technique of treatment, skin reaction, favorable and unfavorable conditions for treatment, etc.

In all cases of lupus vulgaris treated by the authors, a marked and regular improvement has occurred, although in some cases very slowly

Significant improvement has also been shown in lupus erythematosus, although not as reliably as in lupus vulgaris. A case report is cited which definitely indicates that in the treatment of this disease, the aim is to induce the most severe skin inflammation possible.

The authors' remarks on rodent ulcers are interesting. They believe that light has a significant stimulating effect on the tissue in the base and margins of ulcers, both in lupus vulgaris and rodent ulcers, so that soon after treatment, a rapid ingrowth of the epithelium from the surrounding area occurs. In some cases where the epithelium was not ulcerated, the tumor became red, slightly excoriated, and softer after treatment, and gradually disappeared without loss of substance.

VALDEMAR BIE.

STEPHEN MACKENZIE: ON Phototherapy or the Light Treatment on Lupus Vulgaris. The British Journal of Dermatology Vol. 11, No. 133. Lortet et Genoud (Faculté de Medicine de Lyon. La Boratoire de Parasitologie): La Lumière Agent de Therapeutique. Lyon 1900.

Theodor Schüler: On Light Treatment with Special Consideration of Professor Finsen's Treatment with Concentrated Chemical Light Rays. Monthly Journal for Orthopedic Surgery and Physical Healing Methods. Vol. I, No. 3, 1901.

Henry W. Stelvagon: Phototherapy in Cutaneous Medicine. The University Medical Magazine, December 1900

These four treatises contain reports on the author's visit to Finsen's Light Institute,

VALDEMAR BIE.

MAGNUS MÖLLER (Stockholm): The Influence of Light on the Skin in Healthy and Diseased Conditions,

Bibliotheca Medica, Dept. D. II, Dermatology and Syphilidology, ed. by Prof. NEISSER and E. NÄGELE. Stuttgart 1900. 142 pages.

In this book, illustrated with beautiful photographs and biological plates, the author provides a collected description of the investigations of recent years into the effects of light and X-rays on the skin. Partly, the effect of sunlight and electric light on healthy skin is treated with great thoroughness, and partly the significance of light for summer prurigo, hydroa estivalis, xeroderma pigmentosum, and venereal diseases, as well as the effect of light on pellagra and Finsen's treatment of smallpox

The author also describes some of his own illumination experiments, with the associated histological examinations of great interest. He used the same illumination apparatus with which Widmark, in his time, conducted his fundamental experiments on the skin-irritating ability of ultraviolet rays: a water-filled metal cylinder, one end of which was closed with a rock crystal lens with a 13 cm focal length, the other with a flat glass plate with a cutout in which a flat rock crystal plate was cemented. The rays of an electric arc lamp of 1200-4000 standard candles were made parallel using

the aforementioned rock crystal lens and then passed through the water layer and the glass and rock crystal plate, behind which the author illuminated his own or the test animal's skin. His experiments led to very similar results to those of Widmark and Finsen When using appropriate light intensity and exposure time, light erythema appeared only on the skin areas corresponding to the rock crystal plate, while those exposed to rays that had passed through glass showed no such effect. From this, the author concludes that the effect is due to ultraviolet rays, although, as he himself points out, one cannot conclude that visible rays cannot also exert a similar effect on the skin at higher light intensity. As an effect of ultraviolet rays, the author observed, in addition to the well-known vasodilation, a reduced transparency of the epidermis as a result of proliferative processes. This "clouding" of the epidermis became apparent 2-3 days after exposure; it increases in proportion as the photochemical effect decreases and persists until desquamation ceases. It was particularly evident when the treated skin area, e.g., a rabbit's ear, was illuminated with transmitted light. Histologically, this reduced transparency is due to parenchymatous edema, an abnormally increased epithelial sap content with accompanying hyperplasia, which is particularly evident in the stratum corneum, which becomes more than twice as thick as in the normal state and exhibits an abnormal keratinization process in which the nuclei of the stratum corneum cells are preserved and are abnormally influenced by the pigments. This process, induced by ultraviolet rays, serves, in the author's opinion, to protect the deeper layer, similar to the vascular dilation and the subsequent pigmentation.

The author investigated the deeper effects of light, particularly on the ears of white rabbits, by collecting the light on the inside of the ear with the aid of Widmark's apparatus. With the appropriate light intensity, he achieved not only an inflammation limited to the rock crystal area with blistering on the inside of the ear, but also a corresponding, albeit less severe, affection on the outer side. The author regards this as proof of the not insignificant deep effect of ultraviolet rays. Regarding what we otherwise know about the slight

Knowing the deep penetration ability of ultraviolet rays, it is perhaps doubtful whether the author is correct in this assumption; it may rather be a case of collateral fluxion of significant intensity. The histological examination of the vascular dilation showed, among other things, a strong dilation of the smaller arteries; while their lumen generally shows, on section, a more or less contracted muscularis with strongly folded elastica, the illuminated arteries, on the other hand, showed a thin, unfolded muscularis and an almost smooth elastica, so that they resembled veins rather than arteries. When the strongest illumination was used, thrombus formation occurred in the cutaneous vessels

A series of experiments on guinea pigs and rabbits, intended to investigate whether "sunstroke" could be induced by exposing the animals' heads to strong ultraviolet light, led to negative results, with only nervous phenomena occurring in cases where the heat rays were not carefully excluded.

Sophus Bang.

SÖREN HANSEN: On Sunlight in Copenhagen. Some Remarks Regarding the Revision of the Building Code.

Tidsskrift for Sundhetspleje. I R. VII. pp. 65-78.

In this essay, the author wishes to draw attention to the fact that building codes should take the lighting conditions in streets and apartments into account to a much greater degree than is currently the case. Certainly, building regulations are gradually showing a progressive tendency; whereas previously they dealt exclusively with the risk of fire, they now focus more on hygienic conditions However, sufficient consideration of the hygienic importance of light seems to be lacking. Copenhagen is already quite neglected by nature when it comes to sunshine. Of the 4,400 theoretically possible hours of sunshine per year, the sun shines for only 1,200, while Berlin, for example, has 1,727. Of the larger cities, only London (with 1,026 hours) seems to lag behind us. Added to this is the poor quality of a large portion of the sunshine we are granted. One would think that these conditions would require us to construct buildings so that they take as little sunlight as possible from each other; but the author's calculations show that our building regulations, instead of taking advantage of these conditions, actually put us at a disadvantage when it comes to sunshine on facades, compared to cities with which we are almost comparable, such as Berlin. Here, the height of houses may reach 5/4 of the street width, and under certain circumstances even more; in Berlin, the height of houses may not exceed the street width. This means that on a street running from east to west,

With houses 27 cubits high, the northern row of houses in Berlin will have a sunlit area 6 cubits larger in the vertical position during the equinox midday than the corresponding row of houses in Copenhagen. To achieve Berlin's lighting conditions, the southern row of houses in Copenhagen would have to be only 8/9 the width of the street instead of the currently prescribed 5/4. Such requirements cannot, of course, be implemented within the city, but it would be possible for the suburbs, for which the author even proposes the standard ratio of 2/3, which would mean that the southern row of houses could not shade any part of the northern row at the equinox midday. It is to be hoped that the ever-increasing desire for light as a comfort and the growing understanding of the hygienic importance of light will lead the authorities to consider the author's commendable proposal.

SOPHUS BANG

HUGH WALSHAM: On the ultra-violet light from a rapid oscillation high-tension arc, for the treatment of skin diseases. The Lancet. Feb. 1902.

Ultraviolet rays with a wavelength of approximately 200 µµ make the air they pass through conductive for electricity. The author used this property to investigate the penetrating power of these rays. He used an alternating current lamp (not described in detail) as his light source. When the light from this lamp was directed against an electroscope charged with negative electricity, its gold leaves collapsed, and the author used the speed with which this process took place as a measure of the quantity of the rays mentioned. By inserting various bodies between the lamp and the electroscope, he determined their absorption ratio According to his experiments, two 2 mm thick quartz plates spaced 10 mm apart should absorb 60% of the rays acting on — the electroscope. If the space between the plates is filled with water (distilled? boiled?), 10-15% of the remaining rays are absorbed. A gelatin plate 0.04 mm thick blocked all — rays, while a 6-inch thick block of ice absorbed barely more than the corresponding column of air.

This ratio prompted the author to use small inch-thick pieces of ice as compressors instead of Finsen's pressure glass in the light treatment of lupus. The author assumes that the cooling effect of the ice will also contribute to the completion of local ischemia. The fact that the author was — able to use this technique at all is only to explain that he used a weak light source without concentrating the rays to treat lupus, and that the sessions only involved communications from Finsen's

10-15 minutes. — Experiments at Finsen's Light Institute have shown the inadequacy of such methods, and in addition, rays with such great refractile properties are absorbed in the uppermost layer of the skin. The author admits this — by emphasizing that the penetrating power of light rays decreases with their wavelength, but he tries to circumvent the matter with a few words by saying that the wavelength is so easy to lengthen or shorten, even when the rays strike different bodies, that it would not be wise to dogmatize on this point!

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It is clear that such an application of ice as a compressive agent must also be very unpleasant for the patient; the author also does not mention this downside.

GUNNI BUSCK.

G. J. MÜLLER: Actinotherapy. — Medical Calendar of the General Medical Centertralzeitung. 1902. Berlin

Under the name "Actinotherapy," the author summarizes the four modern physical treatment methods below, of which he gives a clear and concise description.

Applications of 1) the concentrated chemical rays of the arc lamp or sunlight according to Prof. Finsen's method,
2) X-rays,
3) the ultraviolet rays of the induction spark according to Strebel's method,
4) Becquerel rays.

In his discussion of concentrated chemical rays, the author essentially follows the views put forward by Prof. Finsen and his students; only, purely theoretically, he places greater emphasis on the inflammatory — properties of the rays than on their bactericidal power.

The author recommends X-rays for for the treatment of. He finds hypertrichosis, sycosis parasitaria, and favus, in — them contraindicated all acute, inflammatory dermatoses, especially —

Strebel's apparatus for utilizing the ultraviolet rays of the induction spark and Becquerel rays (chemically active rays emitted by uranium and thorium) are only mentioned by the author.

GUNNI BUSCK.

Dr. ENGEL (Cairo): On the treatment of smallpox with red light, along with some remarks on forced vaccination.
"Therapy of the Present", March 1901.

During an epidemic that occurred in Egypt in the spring of 1900, a total of 177 smallpox patients were admitted to the Infectious Disease Hospital in Cairo. Of these, 25 were treated according to Finsen's method.

As a result of a well-conducted mass vaccination (in April alone, over 278,000 inhabitants of Cairo were vaccinated or revaccinated), the epidemic ceased shortly after the treatment was initiated

The author publishes his results in the above-mentioned treatise, expressing the hope of thereby contributing to the "publication" of a method which, in the author's opinion, has not yet received the attention and widespread use it deserves.

The author describes the tremendous change that occurred in the sick rooms after the exclusion of chemical rays: the penetrating stench, which had been almost unbearable due to the accumulation of so many suppurating patients, disappeared completely, and with it the numerous flies that had previously been a constant plague for the patients.

The author was unable to observe any harmful effects of exposure to filtered light on the patients or the staff, but he emphasizes that the patients became restless and could only be kept there with difficulty until the vesicles had completely dried out, precisely because subjective well-being — occurred so early

Although the skin eruptions always took on an abortive, benign character without suppuration, the author found that the treatment had no effect on the exanthema localized on the mucous membranes (pharynx, larynx, conjunctiva), and he believes this is the reason for the contradictory results of the various observers regarding the incidence of suppuration fever under Finsen treatment. It is clear from the reported case reports that the affection of the mucous membranes is, on the whole, of great prognostic significance—something to which previous authors (e.g., Curschmann) — have also drawn attention

If, according — to the author, one disregards the fulminating cases of purpura variolosa and variola hemorrhagica, as well as cases where the mucous membranes are primarily severely affected, the disease will progress like variola, and the cosmetic result will be satisfactory from the moment — the patient is treated according to Finsen's method.

The author calls this the first rational and methodical treatment of variola; he believes that it should be introduced everywhere as an obligatory part of smallpox treatment and that permanent facilities for such treatment should be established in all states where smallpox cases occur constantly or only frequently.

As one can see, the author unconditionally and zealously supports the proponents of the . — method. This makes his view of the influence of treatment on mortality. The author does not believe that it will bring about any reduction in the mortality rate, although he also admits that it can have a certain influence on this by preventing mixed infections and complications in the later stages of the disease, which may be of particular importance for old and weak patients.

One should certainly be careful with numbers; but one can also be so careful that the conclusions are misinterpreted. When you go through the author's statistics, it also becomes clear that he was clear-sighted! —
very pre-

The smallpox patients, few of whom had been vaccinated and none of whom had been revaccinated, were interned in two pavilions —A and B. The milder cases were placed in A, the more severe cases in B, and this separation between mild and severe cases was continued in the same way after Finsen treatment was introduced in Pavilion B on May 8th. The probability rate was before —
May 8th in Pav. A: 17% (6 out of 35). 45% (9 out of 20). —
After May 8th in Pav. A: 20% (1 in 5) died. Die-In Pav. B:
— In Pav. B also 20% (5 of 25). Of these 5 patients who died despite the treatment in red light, one was a child who was only brought in at the suppuration stage and thus came under treatment too late, since the importance of the method is that it prevents suppuration. The four others had what the author just highlighted, in addition to a confluent skin rash, an — intense and severe affection of the mucous membranes in the throat and in the trachea. The author draws his conclusions from these numbers!

In various monographs on variola, Referent tried to find statistical information about which days of illness deaths occur most frequently. It goes without saying that Finsen treatment, which only aims to prevent suppuration, cannot have any influence on mortality in the first few days of illness. On the other hand, it is equally clear that the mortality attributable to — cutaneous suppuration and the complications dependent on it is reduced to o, the moment the suppuration is prevented. It

Most authors state that purpura variolosa almost always causes death in the first few days of illness. Apart from these foudroyant cases, the greatest mortality occurs during or after the suppuration period.

Since the author now considers it to be clinically established that by excluding the rays of light that cause inflammation from the patient, they are protected from cutaneous suppuration and its consequences, he must logically conclude that such treatment reduces the mortality rate for variola.

Finally, the author mentions forced vaccination. He believes in the possibility of a beneficial influence on the secondary period,

and thinks that they hardly pose any danger to the patients. and should therefore be tried wherever Finsen's method is not feasible.

Gunni Busck.

DEGRAIS: The rayons chimiques et de leur emploi dans la thérapeutique des affections cutanées. (Traitement du Lupus par l'appareil Finsen.) Thèse. Paris. 1901.

The author has familiarized himself quite thoroughly with the literature that has appeared in recent years on chemical light rays. Magnus Möller and Finsen appear to be his main sources. Without engaging in any kind of criticism, he guides the reader through the entire physiology of light in just a few pages: the influence of light on metabolism, light erythema, pigmentation, excitation and permeability.

After the general part comes a description of phototherapy. Finsen's concentration apparatus for sun and electric light is described in detail. He also describes Lortet et Genouds and Faveau de Cour-melles et Trouvés apparatus, as well as an acetylene lamp given by Callevilles. The author speaks about the latter with great caution. So far we only know the value of the Finsen installation, and the results which the author presents can all be traced back to it, as found in the Saint Louis Hospital (Dr. Balzer's Service). He has a total of 16 medical reports: 13 lupus vulgaris, some cured, some improving. In 3 cases the fin treatment was combined with scarification (Leredde's suggestion), and the author is very satisfied with this. The scarifications were carried out under cocaine anesthesia immediately before the light treatment. The remaining 3 were Lup. erythematous. They proved to be refractory.

Finally, the advantages and disadvantages of fin treatment are compared and the indications for the same are presented, all in essential accordance with Dubois' dissertation (which can be found referenced in this issue).

Hans Jansen.

BAYLE: Contribution to the study of phototherapy. (Finsen method.)

Thesis. Lyons. 1901.

This dissertation is under Prof. Lortet and Dr. Genoud's aegis appeared and therefore concludes with the thesis that her lamp can replace Finsen's. The work is extremely thorough in its entirety and is divided into three sections. The first gives an overview of what was known about the effects of light before Finsen, and particularly highlights the French contribution stands out strongly; the second is devoted exclusively to Finsen's work, and the third deals with Lortet and Genoud's lamp.

With regard to the last section, I can refer to Lortet and Genoud's original treatises, since there is nothing particularly new in Bayle.

HANS JANSEN.

1901. FOVEAU DE COURMELLES: La Finsenthérapie. — Le Médicin. 4 avoût

FOVEAU DE COURMELLES: La Photothérapie. — Le Progrès medical. 2 November 1901.

The articles mentioned are two of the many that the author published in the last six months In all of these, the author moves in a most peculiar way between lyrical outbursts of emotion and strict scientific rigor, summarizing in a blanket manner everything that has been published in the field of light therapy without making any distinctions. The final refrain is always that the only excellent device is an apparatus he himself constructed, which is described and illustrated, but in such a convoluted manner that it has been impossible for the reviewer to form any clear idea. The light source can be either an incandescent lamp with special carbon (lampe à incandescense à charbon spécial), the composition of which has not yet been published, or an ordinary arc lamp. In both cases, only 5-8 amps are necessary; finally, the use of an acetylene lamp is also possible. This light source is mounted in a metal envelope, the rear of which is a parabolic mirror, the front of which is a screen with a quartz disk. The casing consists everywhere of double walls through which water flows. The light source is mounted at the focus of the mirror, whereby all light is emitted at the front as parallel rays. There seems to be no concentration. Only the rays that strike the disk reach the patient. A more detailed criticism of such a weakly defined lamp is impossible; it should only be emphasized that the use of mirrors was attempted here a long time ago, but was abandoned because they are very quickly attacked and ruined, at least when using an arc lamp.

HANS JANSEN

LORTET & GENOUD: Non-condensing phototherapy device. Compt. rend. des séances de l'Acad. des Sciences t. CXXXII p. 527 (March 4, 1901).

LORTET & GENOUD: Non-condensing phototherapy device for the application of Finsen's method,

Lyon Médical (March 17, 1901).

Notice on the non-condensing phototherapy device by Lortet & Genoud,

Professor Lortet, doyen of the medical faculty in Lyon, who was one of the first to introduce Finsen's phototherapy in France, did not limit himself to this. In collaboration with Dr. Genoud, he attempted to devise an improved arrangement for the therapeutic application of arc light, and it is this "lamp" that is presented to the public in these treatises. Although it is hardly as excellent as the authors seem to suppose, there is nevertheless much good in their endeavors, and since the lamp became widely used in France, it contributed greatly to paving the way for phototherapy.

Lortet and Genoud set themselves the goal of 1) avoiding the concentrating apparatus, since it absorbs part of the light, and 2) adapting the lamp for individual treatment so that every general practitioner could have one in his or her office They therefore require an electric projection lamp (a conventional arc lamp with tilted carbon), which emits its light primarily to one side, and place the affected area at a short distance from the arc. This is achieved by inserting a metal screen with double walls, through which cold water flows, between the patient and the light source. This metal screen has a 2.5 cm circular opening just in front of the arc, which is closed with a Finsen water-permeable pressure glass. If the patient is pressed firmly against it, any heating effect is supposedly eliminated. The lamp must be regulated by hand and can be adjusted in every conceivable way using numerous screws. It should burn at 12-15 amps, 55-65 volts, the arc should be at a distance of 2-4 cm from the pressure glass, and the duration of the séances should be only 5-15 minutes (in earlier treatises, 8-10 amps, 1-2 cm distance, and 15-20 minutes are stated).

Quite apart from the fact that it is impractical to position the patient in this way and to regulate the lamp by hand, it is a priori unlikely that this lamp can achieve the same effect as the Finsen installation. It is certainly impossible to investigate the relationship between these two devices by calculation; for, on the one hand, it is not easy to determine how much Lortet gains through the projection position, and, on the other hand, it is not possible to calculate how much Finsen loses through the concentration apparatus. We can only draw attention to the following: 1) Lortet does not fully benefit from the projection position The crater will be slightly positioned to the side of the carbon, but will not be completely vertical, and the rays will therefore not be projected horizontally to the side, but rather a large portion will fall outside or below, thus hitting the printing glass at an unfavorable angle or not at all. 2) The patient is not particularly close to the light source. In addition to the 2-4 cm between the sheet and the printing glass, the latter represents another 2 cm, so the treatment distance is 4-6 cm. With Finsen's treatment distance

One must calculate the distance from the arc to the front lens of the concentrating apparatus; here, the rays are made parallel, and thus they retain their intensity throughout their further travel. This distance is 12 cm for an ordinary 7 cm apparatus. Lortet thus takes the light from a location where it is 4-9 times stronger than where Finsen takes it. But whether this slight advantage, in conjunction to outweigh — with the projection position, should be able — Finsen's concentration, with which the light is amplified about 30 times according to calculations, as well as its 5 times greater power consumption and, finally, its 4-5 times longer treatment time, is unlikely.

Firstly,

The question can only be resolved through exact comparative experiments; Lortet & Genoud do not cite a single one of these. They conclude exclusively from "reactional and curative effects." Exanthema and blistering occur, just as with Finsen treatment; but the authors may not be aware that the Finsen apparatus can achieve exactly the same thing in an even shorter time. The maximum reaction is reached quite quickly, often after just a few minutes, and increasing the illumination time or the light intensity does not significantly change its appearance, although it can be assumed that the depth of effect is all the greater. Finsen was therefore right never to be satisfied with the time and light intensity precisely necessary for maximum effect, but went much further and can probably achieve a greater depth of effect precisely for this reason

It should now only be added that we conducted a series of experiments with Lortet lamps at the local Light Institute, which will be published later, and the main result is that this lamp, in terms of bactericidal power and depth of action, is 3-4 times weaker than a Finsen installation with a 70 amp arc lamp and a 7 cm concentration apparatus and thus represents a significant step backward.

HANS JANSEN.

STREBEL: A LIGHT THERAPY QUESTION. Wiener Klin. Rundschau No. 50-51, 1900,

Strebel: A Contribution to the Question of Light Therapy Instruments. Meeting of the German Dermatological Society. Breslau 1901. Strebel: The Usefulness of Induction Spark Light in Therapy. Lecture. The 73rd Meeting of German Natural Scientists and Physicians. Hamburg 1901.

In recent years, Dr. Strebel in Munich has occupied himself with phototherapy with great zeal, particularly with its physical side, and has demonstrated considerable expertise in this field, although, on average, he has also been very critical, even if, as the speaker believes, he is inclined to put forward hypotheses that are not entirely well-founded.

In the first treatise, the author rightly rejects the widely used light boxes, regardless of whether they are equipped with arc lamps or incandescent lamps. They achieve little photochemically, and harmful gases are collected in them. Instead, he suggests having the patient lie in powerful projection arc lamps with mirror reflectors. He considers inserting colored glass plates pointless. While the author here generally campaigns against the strong charlatanism that is practiced with the use of various lights, he touches on the treatment of smallpox and shows a remarkable lack of understanding by saying that he cannot see why red light should be used; darkness must achieve exactly the same thing.

In the second, the author deals with the important and modern question of the value of ultraviolet rays. He points out their significant absorption through a series of experiments; he finds that a 1-mm horn plate absorbs most of them, just like glass Possibly, they could penetrate better in concentrated form. He tests this by using a quartz lens, which collects ultraviolet rays differentiated by a prism, to project the light cone against a piece of skin and hold a fluorescent screen behind it. While no fluorescence was visible after penetrating a compressed rabbit's ear, visible fluorescence appeared after passing through freshly removed human skin. Apart from this experiment, which one would have liked to repeat and vary, he concludes that the outer ultraviolet rays have only little value when it comes to penetrating the skin. Finally, the author suggests replacing lens concentration with mirrors. A new mirror metal, Magnalia, has been invented, which is supposed to be more resistant to the ozone effect of arc light. Using several drawings, he shows how he envisions the installation in such a case. In the same lecture, but without any connection to the rest, the author presents his "spark light" on the main topic.

of the third treatise. The principle of this Strebel lamp is to allow strong induction sparks to arc between electrodes made of aluminum, calcium, or zinc. This produces a very strong, yet only slightly luminous light with ultraviolet rays. It is almost completely cold, so that it can be introduced into the body cavities, and here the author also wants to seek an area for "ultraviolet therapy," as he believes that the mucous membranes are more penetrable than the skin. Finally, he presents some therapeutic results achieved with this light, including two cases of gon. fluor. albus and two cases of urethritis in men.

Hans Jansen

Printed by August Pries in Leipzig

Published by F. C. W. Vogel in Leipzig.

On the Significance

of Chemical Rays of Light for Medicine and Biology.

Three treatises by Prof.
Dr.
Niels R. Finsen in Copenhagen. With 6
illustrations and 6 plates, size 8. 1899.
Price: M. 2.50.

On the Application of Concentrated Chemical
Light Rays in Medicine
by
Prof. Dr. Niels R. Finsen in Copenhagen. With 4
illustrations and 2 plates. size 80.
1899. Price: M. 1.20.

Communications from Finsen's Medicinske Lysinstitut
(Finsen's Medical Light Institute)
in Copenhagen.

I. II. Edited by Prof. Dr. Niels R. Finsen

The German edition edited by Dr. Valdemar
laboratory assistant at
the institute. 1900, 1901, price 3
Bie. marks each.

Printed by August Pries in Leipzig.

FINSEN, MEDICAL LIGHT INSTITUTE. II. HEET.

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COMMUNICATIONS FROM
FINSEN'S
MEDICINSKE LYSINSTITUT
(FINSEN'S MEDICAL LIGHT INSTITUTE) IN COPENHAGEN

III

EDITED BY PROF. DR. NIELS R. FINSEN

THE GERMAN EDITION EDITED

BY DR. VALDEMAR BIE, LABORATORY
ASSISTANT AT THE INSTITUTE

LEIPZIG
PUBLISHED BY F. C. W. VOGEL 1903